PROJECT MANUAL

Louisa May Alcott Community School

Louisa May Alcott Community School

Mapleton, Utah

Prepared by
Babcock Design

Mapleton Utah 84664
Project Number 26526

Louisa May Alcott
Community School

DOCUMENT 00 01 07 - SEALS PAGE

PART 1 - GENERAL

1.1 DESIGN PROFESSIONALS OF RECORD

A. Architect:

1. Ricky Parkinson or Wes Baker.

   a. ricky@babcockdesign.com or wes@babcockdesign.com

2. Responsible for Divisions 00-14 Sections except where indicated as prepared by other design professionals of record.

B. Architect Firm:

1. Babcock Design.

C. Civil Engineer:

1. Ensign Engineering.

   a. Corey Child - cchild@ensigneng.com

D. Interior Designer:

1. Babcock Design.

E. Landscape Architect:

1. .

F. Structural Engineer:

1. BHB Engineers.

   a. Chris Bratt: chris.bratt@bhbengineers.com

G. Mechanical Engineer, Plumbing:

1. Lynk Engineers.

   a. Reg Hamilton - reg.hamilton@lynkengineers.com

2. Responsible for Divisions 21-22 Sections.

H. Mechanical Engineer, HVAC:

1. Lynk Engineers.

   a. Reg Hamilton - reg.hamilton@lynkengineers.com

2. Responsible for .

I. Electrical Engineer:

1. Lynk Engineers.

   a. Scott Kingery - scott.kingery@lynkengineers.com

2. Responsible for Divisions 26-28 Sections.

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PART 2 - PRODUCTS (Not Used)
PART 3 - EXECUTION (Not Used)

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EXAMPLE

DIGITAL DATA LICENSING AND RELEASE AGREEMENT

[insert date]

1 PARTIES

Transmitting Party:
Architect of Record: Babcock Design
Address 52 Exchange Place, Salt Lake City, UT 84111

Contact:

Receiving Party:
Company Name:
Address:

Contact:

2 PROJECT

Project Name:
Project Number:
Project Location:

3 DEFINITIONS

“Digital Data” means information, communications, drawings, or designs created or stored for the Project in digital form, including but not limited to Building Information Modeling (BIM) files (.rvt), CAD files (.dwg), exports from BIM, specifications, and other digital formats.

4 TERMS AND CONDITIONS

All Digital Data remain the property of the Transmitting Party and are considered Instruments of Service as defined in AIA Document B101™ (or other agreement) and shall not be considered Contract Documents in whole or in part. The transmission of these documents does not transfer any ownership or intellectual property rights. No licenses are granted except as expressly stated in this Agreement.

The Transmitting Party grants to the Receiving Party a non-exclusive, non-transferable license to use the Digital Data solely in connection with the referenced Project. The Receiving Party shall not use the Digital Data for any other purpose, including but not limited to, additions to the Project, other projects, or for completion of the Project by others without prior written consent. The Receiving Party shall not alter or misuse the Digital Data and shall bear all responsibility for their use.

The Digital Data may have been converted from the original formats and are provided 'as-is'. All title blocks, consultant identification, and proprietary marks must be removed prior to submittal by the Receiving Party. Redistribution or reproduction of Digital Data outside the Receiving Party’s organization is prohibited.

The Transmitting Party reserves the right to revoke the license granted under this Agreement at any time upon written notice to the Receiving Party. Upon such revocation, the Receiving Party shall immediately cease all use of the Digital Data and, upon request, shall return or destroy all copies in its possession.

EXAMPLE

The Receiving Party accepts the Digital Data 'as-is' and assumes all risk associated with their use. The Transmitting Party makes no representation as to the accuracy, completeness, or compatibility of the Digital Data with any software or hardware and the Receiving Party is responsible for field verification.

To the fullest extent permitted by law, the Receiving Party shall indemnify, defend, and hold harmless the Transmitting Party and its consultants from any and all claims, losses, damages, liabilities, including attorney's fees, arising out of or resulting from the use or misuse of the Digital Data.

The Receiving Party agrees to pay the Transmitting Party the following fee or other compensation for the Receiving Party's use of the Digital Data:

[n/a] or [insert amount]

5 CONFIDENTIALITY

The Receiving Party shall not disclose or distribute the Digital Data to any third party without prior written consent of the Transmitting Party, except as required by law. The Receiving Party shall take reasonable precautions to protect the confidentiality of the data.

6 TERMINATION

This Agreement shall terminate one year from the date below or upon Substantial Completion of the Project as defined in AIA Document A201™–2007, whichever occurs first, unless otherwise agreed in writing by both parties.

7 GOVERNING LAW

This Agreement shall be governed by the laws of the principal place of business of the Transmitting Party.

8 AGREEMENT

This Agreement constitutes the entire understanding between the parties concerning the release and use of Digital Data. No modification shall be valid unless made in writing and signed by both parties.

This Agreement is intended to supplement, and not replace, any existing agreement between the parties, including but not limited to owner-architect agreements, consultant agreements, or standard AIA contract documents such as AIA Document B101 or C401. In the event of a conflict between this Agreement and any such agreement, the terms of the broader project contract shall govern to the extent necessary.

9 ACCEPTANCE AND SIGNATURES

Authorized Representative, Transmitting Party (AOR)	Authorized Representative, Receiving Party
Name: _____	Name: _____
Date: _____	Date: _____

EXAMPLE

EXHIBIT A: DIGITAL DATA RELEASED

The following digital files are being transmitted under the terms of this Agreement. Please check the applicable format(s) and provide the file name or model designation as appropriate.

REQUESTED DATA *(PLEASE LIST SHEETS OR MODEL DATA TO BE PROVIDED):*

PROVIDE IN THE FOLLOWING FORMAT(S)

☐ Revit Model (.rvt)

File will be purged to remove any proprietary information, views, families and is intended to provide modeled geometry only. Level of Development to generally be LOD 200-300 as defined in the AIA E202-2022..

☐ AutoCAD Drawing (.dwg)

☐ Navisworks File (.nwd/.nwc)

☐ PDF Document (.pdf)

☐ IFC File (.ifc)

☐ Excel or CSV Schedule (.xlsx/.csv)

☑ Other (please specify)

EXAMPLE

AIA® Document A201™ – 2007

General Conditions of the Contract for Construction

for the following PROJECT:
(Name and location or address)

THE OWNER:
(Name, legal status and address)

THE ARCHITECT:
(Name, legal status and address)

ADDITIONS AND DELETIONS:
The author of this document has added information needed for its completion. The author may also have revised the text of the original AIA standard form. An *Additions and Deletions Report* that notes added information as well as revisions to the standard form text is available from the author and should be reviewed. A vertical line in the left margin of this document indicates where the author has added necessary information and where the author has added to or deleted from the original AIA text.

This document has important legal consequences. Consultation with an attorney is encouraged with respect to its completion or modification.

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ARTICLE 1 GENERAL PROVISIONS

§ 1.1 BASIC DEFINITIONS

§ 1.1.1 THE CONTRACT DOCUMENTS

The Contract Documents are enumerated in the Agreement between the Owner and Contractor (hereinafter the Agreement) and consist of the Agreement, Conditions of the Contract (General, Supplementary and other Conditions), Drawings, Specifications, Addenda issued prior to execution of the Contract, other documents listed in the Agreement and Modifications issued after execution of the Contract. A Modification is (1) a written amendment to the Contract signed by both parties, (2) a Change Order, (3) a Construction Change Directive or (4) a written order for a minor change in the Work issued by the Architect. Unless specifically enumerated in the Agreement, the Contract Documents do not include the advertisement or invitation to bid, Instructions to Bidders, sample forms, other information furnished by the Owner in anticipation of receiving bids or proposals, the Contractor's bid or proposal, or portions of Addenda relating to bidding requirements.

§ 1.1.2 THE CONTRACT

The Contract Documents form the Contract for Construction. The Contract represents the entire and integrated agreement between the parties hereto and supersedes prior negotiations, representations or agreements, either written or oral. The Contract may be amended or modified only by a Modification. The Contract Documents shall not be construed to create a contractual relationship of any kind (1) between the Contractor and the Architect or the Architect's consultants, (2) between the Owner and a Subcontractor or a Sub-subcontractor, (3) between the Owner and the Architect or the Architect's consultants or (4) between any persons or entities other than the Owner and the Contractor. The Architect shall, however, be entitled to performance and enforcement of obligations under the Contract intended to facilitate performance of the Architect's duties.

§ 1.1.3 THE WORK

The term "Work" means the construction and services required by the Contract Documents, whether completed or partially completed, and includes all other labor, materials, equipment and services provided or to be provided by the Contractor to fulfill the Contractor's obligations. The Work may constitute the whole or a part of the Project.

§ 1.1.4 THE PROJECT

The Project is the total construction of which the Work performed under the Contract Documents may be the whole or a part and which may include construction by the Owner and by separate contractors.

§ 1.1.5 THE DRAWINGS

The Drawings are the graphic and pictorial portions of the Contract Documents showing the design, location and dimensions of the Work, generally including plans, elevations, sections, details, schedules and diagrams.

§ 1.1.6 THE SPECIFICATIONS

The Specifications are that portion of the Contract Documents consisting of the written requirements for materials, equipment, systems, standards and workmanship for the Work, and performance of related services.

§ 1.1.7 INSTRUMENTS OF SERVICE

Instruments of Service are representations, in any medium of expression now known or later developed, of the tangible and intangible creative work performed by the Architect and the Architect's consultants under their respective professional services agreements. Instruments of Service may include, without limitation, studies, surveys, models, sketches, drawings, specifications, and other similar materials.

§ 1.1.8 INITIAL DECISION MAKER

The Initial Decision Maker is the person identified in the Agreement to render initial decisions on Claims in accordance with Section 15.2 and certify termination of the Agreement under Section 14.2.2.

§ 1.2 CORRELATION AND INTENT OF THE CONTRACT DOCUMENTS

§ 1.2.1 The intent of the Contract Documents is to include all items necessary for the proper execution and completion of the Work by the Contractor. The Contract Documents are complementary, and what is required by one shall be as binding as if required by all; performance by the Contractor shall be required only to the extent consistent with the Contract Documents and reasonably inferable from them as being necessary to produce the indicated results.

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§ 1.2.2 Organization of the Specifications into divisions, sections and articles, and arrangement of Drawings shall not control the Contractor in dividing the Work among Subcontractors or in establishing the extent of Work to be performed by any trade.

§ 1.2.3 Unless otherwise stated in the Contract Documents, words that have well-known technical or construction industry meanings are used in the Contract Documents in accordance with such recognized meanings.

§ 1.3 CAPITALIZATION

Terms capitalized in these General Conditions include those that are (1) specifically defined, (2) the titles of numbered articles or (3) the titles of other documents published by the American Institute of Architects.

§ 1.4 INTERPRETATION

In the interest of brevity the Contract Documents frequently omit modifying words such as "all" and "any" and articles such as "the" and "an," but the fact that a modifier or an article is absent from one statement and appears in another is not intended to affect the interpretation of either statement.

§ 1.5 OWNERSHIP AND USE OF DRAWINGS, SPECIFICATIONS AND OTHER INSTRUMENTS OF SERVICE

§ 1.5.1 The Architect and the Architect's consultants shall be deemed the authors and owners of their respective Instruments of Service, including the Drawings and Specifications, and will retain all common law, statutory and other reserved rights, including copyrights. The Contractor, Subcontractors, Sub-subcontractors, and material or equipment suppliers shall not own or claim a copyright in the Instruments of Service. Submittal or distribution to meet official regulatory requirements or for other purposes in connection with this Project is not to be construed as publication in derogation of the Architect's or Architect's consultants' reserved rights.

§ 1.5.2 The Contractor, Subcontractors, Sub-subcontractors and material or equipment suppliers are authorized to use and reproduce the Instruments of Service provided to them solely and exclusively for execution of the Work. All copies made under this authorization shall bear the copyright notice, if any, shown on the Instruments of Service. The Contractor, Subcontractors, Sub-subcontractors, and material or equipment suppliers may not use the Instruments of Service on other projects or for additions to this Project outside the scope of the Work without the specific written consent of the Owner, Architect and the Architect's consultants.

§ 1.6 TRANSMISSION OF DATA IN DIGITAL FORM

If the parties intend to transmit Instruments of Service or any other information or documentation in digital form, they shall endeavor to establish necessary protocols governing such transmissions, unless otherwise already provided in the Agreement or the Contract Documents.

ARTICLE 2 OWNER

§ 2.1 GENERAL

§ 2.1.1 The Owner is the person or entity identified as such in the Agreement and is referred to throughout the Contract Documents as if singular in number. The Owner shall designate in writing a representative who shall have express authority to bind the Owner with respect to all matters requiring the Owner's approval or authorization. Except as otherwise provided in Section 4.2.1, the Architect does not have such authority. The term "Owner" means the Owner or the Owner's authorized representative.

§ 2.1.2 The Owner shall furnish to the Contractor within fifteen days after receipt of a written request, information necessary and relevant for the Contractor to evaluate, give notice of or enforce mechanic's lien rights. Such information shall include a correct statement of the record legal title to the property on which the Project is located, usually referred to as the site, and the Owner's interest therein.

§ 2.2 INFORMATION AND SERVICES REQUIRED OF THE OWNER

§ 2.2.1 Prior to commencement of the Work, the Contractor may request in writing that the Owner provide reasonable evidence that the Owner has made financial arrangements to fulfill the Owner's obligations under the Contract. Thereafter, the Contractor may only request such evidence if (1) the Owner fails to make payments to the Contractor as the Contract Documents require; (2) a change in the Work materially changes the Contract Sum; or (3) the Contractor identifies in writing a reasonable concern regarding the Owner's ability to make payment when due. The Owner shall furnish such evidence as a condition precedent to commencement or continuation of the Work or

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the portion of the Work affected by a material change. After the Owner furnishes the evidence, the Owner shall not materially vary such financial arrangements without prior notice to the Contractor.

§ 2.2.2 Except for permits and fees that are the responsibility of the Contractor under the Contract Documents, including those required under Section 3.7.1, the Owner shall secure and pay for necessary approvals, easements, assessments and charges required for construction, use or occupancy of permanent structures or for permanent changes in existing facilities.

§ 2.2.3 The Owner shall furnish surveys describing physical characteristics, legal limitations and utility locations for the site of the Project, and a legal description of the site. The Contractor shall be entitled to rely on the accuracy of information furnished by the Owner but shall exercise proper precautions relating to the safe performance of the Work.

§ 2.2.4 The Owner shall furnish information or services required of the Owner by the Contract Documents with reasonable promptness. The Owner shall also furnish any other information or services under the Owner's control and relevant to the Contractor's performance of the Work with reasonable promptness after receiving the Contractor's written request for such information or services.

§ 2.2.5 Unless otherwise provided in the Contract Documents, the Owner shall furnish to the Contractor one copy of the Contract Documents for purposes of making reproductions pursuant to Section 1.5.2.

§ 2.3 OWNER'S RIGHT TO STOP THE WORK

If the Contractor fails to correct Work that is not in accordance with the requirements of the Contract Documents as required by Section 12.2 or repeatedly fails to carry out Work in accordance with the Contract Documents, the Owner may issue a written order to the Contractor to stop the Work, or any portion thereof, until the cause for such order has been eliminated; however, the right of the Owner to stop the Work shall not give rise to a duty on the part of the Owner to exercise this right for the benefit of the Contractor or any other person or entity, except to the extent required by Section 6.1.3.

§ 2.4 OWNER'S RIGHT TO CARRY OUT THE WORK

If the Contractor defaults or neglects to carry out the Work in accordance with the Contract Documents and fails within a ten-day period after receipt of written notice from the Owner to commence and continue correction of such default or neglect with diligence and promptness, the Owner may, without prejudice to other remedies the Owner may have, correct such deficiencies. In such case an appropriate Change Order shall be issued deducting from payments then or thereafter due the Contractor the reasonable cost of correcting such deficiencies, including Owner's expenses and compensation for the Architect's additional services made necessary by such default, neglect or failure. Such action by the Owner and amounts charged to the Contractor are both subject to prior approval of the Architect. If payments then or thereafter due the Contractor are not sufficient to cover such amounts, the Contractor shall pay the difference to the Owner.

ARTICLE 3 CONTRACTOR

§ 3.1 GENERAL

§ 3.1.1 The Contractor is the person or entity identified as such in the Agreement and is referred to throughout the Contract Documents as if singular in number. The Contractor shall be lawfully licensed, if required in the jurisdiction where the Project is located. The Contractor shall designate in writing a representative who shall have express authority to bind the Contractor with respect to all matters under this Contract. The term "Contractor" means the Contractor or the Contractor's authorized representative.

§ 3.1.2 The Contractor shall perform the Work in accordance with the Contract Documents.

§ 3.1.3 The Contractor shall not be relieved of obligations to perform the Work in accordance with the Contract Documents either by activities or duties of the Architect in the Architect's administration of the Contract, or by tests, inspections or approvals required or performed by persons or entities other than the Contractor.

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§ 3.2 REVIEW OF CONTRACT DOCUMENTS AND FIELD CONDITIONS BY CONTRACTOR

§ 3.2.1 Execution of the Contract by the Contractor is a representation that the Contractor has visited the site, become generally familiar with local conditions under which the Work is to be performed and correlated personal observations with requirements of the Contract Documents.

§ 3.2.2 Because the Contract Documents are complementary, the Contractor shall, before starting each portion of the Work, carefully study and compare the various Contract Documents relative to that portion of the Work, as well as the information furnished by the Owner pursuant to Section 2.2.3, shall take field measurements of any existing conditions related to that portion of the Work, and shall observe any conditions at the site affecting it. These obligations are for the purpose of facilitating coordination and construction by the Contractor and are not for the purpose of discovering errors, omissions, or inconsistencies in the Contract Documents; however, the Contractor shall promptly report to the Architect any errors, inconsistencies or omissions discovered by or made known to the Contractor as a request for information in such form as the Architect may require. It is recognized that the Contractor's review is made in the Contractor's capacity as a contractor and not as a licensed design professional, unless otherwise specifically provided in the Contract Documents.

§ 3.2.3 The Contractor is not required to ascertain that the Contract Documents are in accordance with applicable laws, statutes, ordinances, codes, rules and regulations, or lawful orders of public authorities, but the Contractor shall promptly report to the Architect any nonconformity discovered by or made known to the Contractor as a request for information in such form as the Architect may require.

§ 3.2.4 If the Contractor believes that additional cost or time is involved because of clarifications or instructions the Architect issues in response to the Contractor's notices or requests for information pursuant to Sections 3.2.2 or 3.2.3, the Contractor shall make Claims as provided in Article 15. If the Contractor fails to perform the obligations of Sections 3.2.2 or 3.2.3, the Contractor shall pay such costs and damages to the Owner as would have been avoided if the Contractor had performed such obligations. If the Contractor performs those obligations, the Contractor shall not be liable to the Owner or Architect for damages resulting from errors, inconsistencies or omissions in the Contract Documents, for differences between field measurements or conditions and the Contract Documents, or for nonconformities of the Contract Documents to applicable laws, statutes, ordinances, codes, rules and regulations, and lawful orders of public authorities.

§ 3.3 SUPERVISION AND CONSTRUCTION PROCEDURES

§ 3.3.1 The Contractor shall supervise and direct the Work, using the Contractor's best skill and attention. The Contractor shall be solely responsible for, and have control over, construction means, methods, techniques, sequences and procedures and for coordinating all portions of the Work under the Contract, unless the Contract Documents give other specific instructions concerning these matters. If the Contract Documents give specific instructions concerning construction means, methods, techniques, sequences or procedures, the Contractor shall evaluate the jobsite safety thereof and, except as stated below, shall be fully and solely responsible for the jobsite safety of such means, methods, techniques, sequences or procedures. If the Contractor determines that such means, methods, techniques, sequences or procedures may not be safe, the Contractor shall give timely written notice to the Owner and Architect and shall not proceed with that portion of the Work without further written instructions from the Architect. If the Contractor is then instructed to proceed with the required means, methods, techniques, sequences or procedures without acceptance of changes proposed by the Contractor, the Owner shall be solely responsible for any loss or damage arising solely from those Owner-required means, methods, techniques, sequences or procedures.

§ 3.3.2 The Contractor shall be responsible to the Owner for acts and omissions of the Contractor's employees, Subcontractors and their agents and employees, and other persons or entities performing portions of the Work for, or on behalf of, the Contractor or any of its Subcontractors.

§ 3.3.3 The Contractor shall be responsible for inspection of portions of Work already performed to determine that such portions are in proper condition to receive subsequent Work.

§ 3.4 LABOR AND MATERIALS

§ 3.4.1 Unless otherwise provided in the Contract Documents, the Contractor shall provide and pay for labor, materials, equipment, tools, construction equipment and machinery, water, heat, utilities, transportation, and other

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facilities and services necessary for proper execution and completion of the Work, whether temporary or permanent and whether or not incorporated or to be incorporated in the Work.

§ 3.4.2 Except in the case of minor changes in the Work authorized by the Architect in accordance with Sections 3.12.8 or 7.4, the Contractor may make substitutions only with the consent of the Owner, after evaluation by the Architect and in accordance with a Change Order or Construction Change Directive.

§ 3.4.3 The Contractor shall enforce strict discipline and good order among the Contractor's employees and other persons carrying out the Work. The Contractor shall not permit employment of unfit persons or persons not properly skilled in tasks assigned to them.

§ 3.5 WARRANTY

The Contractor warrants to the Owner and Architect that materials and equipment furnished under the Contract will be of good quality and new unless the Contract Documents require or permit otherwise. The Contractor further warrants that the Work will conform to the requirements of the Contract Documents and will be free from defects, except for those inherent in the quality of the Work the Contract Documents require or permit. Work, materials, or equipment not conforming to these requirements may be considered defective. The Contractor's warranty excludes remedy for damage or defect caused by abuse, alterations to the Work not executed by the Contractor, improper or insufficient maintenance, improper operation, or normal wear and tear and normal usage. If required by the Architect, the Contractor shall furnish satisfactory evidence as to the kind and quality of materials and equipment.

§ 3.6 TAXES

The Contractor shall pay sales, consumer, use and similar taxes for the Work provided by the Contractor that are legally enacted when bids are received or negotiations concluded, whether or not yet effective or merely scheduled to go into effect.

§ 3.7 PERMITS, FEES, NOTICES AND COMPLIANCE WITH LAWS

§ 3.7.1 Unless otherwise provided in the Contract Documents, the Contractor shall secure and pay for the building permit as well as for other permits, fees, licenses, and inspections by government agencies necessary for proper execution and completion of the Work that are customarily secured after execution of the Contract and legally required at the time bids are received or negotiations concluded.

§ 3.7.2 The Contractor shall comply with and give notices required by applicable laws, statutes, ordinances, codes, rules and regulations, and lawful orders of public authorities applicable to performance of the Work.

§ 3.7.3 If the Contractor performs Work knowing it to be contrary to applicable laws, statutes, ordinances, codes, rules and regulations, or lawful orders of public authorities, the Contractor shall assume appropriate responsibility for such Work and shall bear the costs attributable to correction.

§ 3.7.4 Concealed or Unknown Conditions. If the Contractor encounters conditions at the site that are (1) subsurface or otherwise concealed physical conditions that differ materially from those indicated in the Contract Documents or (2) unknown physical conditions of an unusual nature, that differ materially from those ordinarily found to exist and generally recognized as inherent in construction activities of the character provided for in the Contract Documents, the Contractor shall promptly provide notice to the Owner and the Architect before conditions are disturbed and in no event later than 21 days after first observance of the conditions. The Architect will promptly investigate such conditions and, if the Architect determines that they differ materially and cause an increase or decrease in the Contractor's cost of, or time required for, performance of any part of the Work, will recommend an equitable adjustment in the Contract Sum or Contract Time, or both. If the Architect determines that the conditions at the site are not materially different from those indicated in the Contract Documents and that no change in the terms of the Contract is justified, the Architect shall promptly notify the Owner and Contractor in writing, stating the reasons. If either party disputes the Architect's determination or recommendation, that party may proceed as provided in Article 15.

§ 3.7.5 If, in the course of the Work, the Contractor encounters human remains or recognizes the existence of burial markers, archaeological sites or wetlands not indicated in the Contract Documents, the Contractor shall immediately suspend any operations that would affect them and shall notify the Owner and Architect. Upon receipt of such notice, the Owner shall promptly take any action necessary to obtain governmental authorization required to resume

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the operations. The Contractor shall continue to suspend such operations until otherwise instructed by the Owner but shall continue with all other operations that do not affect those remains or features. Requests for adjustments in the Contract Sum and Contract Time arising from the existence of such remains or features may be made as provided in Article 15.

§ 3.8 ALLOWANCES

§ 3.8.1 The Contractor shall include in the Contract Sum all allowances stated in the Contract Documents. Items covered by allowances shall be supplied for such amounts and by such persons or entities as the Owner may direct, but the Contractor shall not be required to employ persons or entities to whom the Contractor has reasonable objection.

§ 3.8.2 Unless otherwise provided in the Contract Documents,

- **.1** Allowances shall cover the cost to the Contractor of materials and equipment delivered at the site and all required taxes, less applicable trade discounts;
- **.2** Contractor's costs for unloading and handling at the site, labor, installation costs, overhead, profit and other expenses contemplated for stated allowance amounts shall be included in the Contract Sum but not in the allowances; and
- **.3** Whenever costs are more than or less than allowances, the Contract Sum shall be adjusted accordingly by Change Order. The amount of the Change Order shall reflect (1) the difference between actual costs and the allowances under Section 3.8.2.1 and (2) changes in Contractor's costs under Section 3.8.2.2.

§ 3.8.3 Materials and equipment under an allowance shall be selected by the Owner with reasonable promptness.

§ 3.9 SUPERINTENDENT

§ 3.9.1 The Contractor shall employ a competent superintendent and necessary assistants who shall be in attendance at the Project site during performance of the Work. The superintendent shall represent the Contractor, and communications given to the superintendent shall be as binding as if given to the Contractor.

§ 3.9.2 The Contractor, as soon as practicable after award of the Contract, shall furnish in writing to the Owner through the Architect the name and qualifications of a proposed superintendent. The Architect may reply within 14 days to the Contractor in writing stating (1) whether the Owner or the Architect has reasonable objection to the proposed superintendent or (2) that the Architect requires additional time to review. Failure of the Architect to reply within the 14 day period shall constitute notice of no reasonable objection.

§ 3.9.3 The Contractor shall not employ a proposed superintendent to whom the Owner or Architect has made reasonable and timely objection. The Contractor shall not change the superintendent without the Owner's consent, which shall not unreasonably be withheld or delayed.

§ 3.10 CONTRACTOR'S CONSTRUCTION SCHEDULES

§ 3.10.1 The Contractor, promptly after being awarded the Contract, shall prepare and submit for the Owner's and Architect's information a Contractor's construction schedule for the Work. The schedule shall not exceed time limits current under the Contract Documents, shall be revised at appropriate intervals as required by the conditions of the Work and Project, shall be related to the entire Project to the extent required by the Contract Documents, and shall provide for expeditious and practicable execution of the Work.

§ 3.10.2 The Contractor shall prepare a submittal schedule, promptly after being awarded the Contract and thereafter as necessary to maintain a current submittal schedule, and shall submit the schedule(s) for the Architect's approval. The Architect's approval shall not unreasonably be delayed or withheld. The submittal schedule shall (1) be coordinated with the Contractor's construction schedule, and (2) allow the Architect reasonable time to review submittals. If the Contractor fails to submit a submittal schedule, the Contractor shall not be entitled to any increase in Contract Sum or extension of Contract Time based on the time required for review of submittals.

§ 3.10.3 The Contractor shall perform the Work in general accordance with the most recent schedules submitted to the Owner and Architect.

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§ 3.11 DOCUMENTS AND SAMPLES AT THE SITE

The Contractor shall maintain at the site for the Owner one copy of the Drawings, Specifications, Addenda, Change Orders and other Modifications, in good order and marked currently to indicate field changes and selections made during construction, and one copy of approved Shop Drawings, Product Data, Samples and similar required submittals. These shall be available to the Architect and shall be delivered to the Architect for submittal to the Owner upon completion of the Work as a record of the Work as constructed.

§ 3.12 SHOP DRAWINGS, PRODUCT DATA AND SAMPLES

§ 3.12.1 Shop Drawings are drawings, diagrams, schedules and other data specially prepared for the Work by the Contractor or a Subcontractor, Sub-subcontractor, manufacturer, supplier or distributor to illustrate some portion of the Work.

§ 3.12.2 Product Data are illustrations, standard schedules, performance charts, instructions, brochures, diagrams and other information furnished by the Contractor to illustrate materials or equipment for some portion of the Work.

§ 3.12.3 Samples are physical examples that illustrate materials, equipment or workmanship and establish standards by which the Work will be judged.

§ 3.12.4 Shop Drawings, Product Data, Samples and similar submittals are not Contract Documents. Their purpose is to demonstrate the way by which the Contractor proposes to conform to the information given and the design concept expressed in the Contract Documents for those portions of the Work for which the Contract Documents require submittals. Review by the Architect is subject to the limitations of Section 4.2.7. Informational submittals upon which the Architect is not expected to take responsive action may be so identified in the Contract Documents. Submittals that are not required by the Contract Documents may be returned by the Architect without action.

§ 3.12.5 The Contractor shall review for compliance with the Contract Documents, approve and submit to the Architect Shop Drawings, Product Data, Samples and similar submittals required by the Contract Documents in accordance with the submittal schedule approved by the Architect or, in the absence of an approved submittal schedule, with reasonable promptness and in such sequence as to cause no delay in the Work or in the activities of the Owner or of separate contractors.

§ 3.12.6 By submitting Shop Drawings, Product Data, Samples and similar submittals, the Contractor represents to the Owner and Architect that the Contractor has (1) reviewed and approved them, (2) determined and verified materials, field measurements and field construction criteria related thereto, or will do so and (3) checked and coordinated the information contained within such submittals with the requirements of the Work and of the Contract Documents.

§ 3.12.7 The Contractor shall perform no portion of the Work for which the Contract Documents require submittal and review of Shop Drawings, Product Data, Samples or similar submittals until the respective submittal has been approved by the Architect.

§ 3.12.8 The Work shall be in accordance with approved submittals except that the Contractor shall not be relieved of responsibility for deviations from requirements of the Contract Documents by the Architect's approval of Shop Drawings, Product Data, Samples or similar submittals unless the Contractor has specifically informed the Architect in writing of such deviation at the time of submittal and (1) the Architect has given written approval to the specific deviation as a minor change in the Work, or (2) a Change Order or Construction Change Directive has been issued authorizing the deviation. The Contractor shall not be relieved of responsibility for errors or omissions in Shop Drawings, Product Data, Samples or similar submittals by the Architect's approval thereof.

§ 3.12.9 The Contractor shall direct specific attention, in writing or on resubmitted Shop Drawings, Product Data, Samples or similar submittals, to revisions other than those requested by the Architect on previous submittals. In the absence of such written notice, the Architect's approval of a resubmission shall not apply to such revisions.

§ 3.12.10 The Contractor shall not be required to provide professional services that constitute the practice of architecture or engineering unless such services are specifically required by the Contract Documents for a portion of the Work or unless the Contractor needs to provide such services in order to carry out the Contractor's responsibilities for construction means, methods, techniques, sequences and procedures. The Contractor shall not be

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required to provide professional services in violation of applicable law. If professional design services or certifications by a design professional related to systems, materials or equipment are specifically required of the Contractor by the Contract Documents, the Owner and the Architect will specify all performance and design criteria that such services must satisfy. The Contractor shall cause such services or certifications to be provided by a properly licensed design professional, whose signature and seal shall appear on all drawings, calculations, specifications, certifications, Shop Drawings and other submittals prepared by such professional. Shop Drawings and other submittals related to the Work designed or certified by such professional, if prepared by others, shall bear such professional's written approval when submitted to the Architect. The Owner and the Architect shall be entitled to rely upon the adequacy, accuracy and completeness of the services, certifications and approvals performed or provided by such design professionals, provided the Owner and Architect have specified to the Contractor all performance and design criteria that such services must satisfy. Pursuant to this Section 3.12.10, the Architect will review, approve or take other appropriate action on submittals only for the limited purpose of checking for conformance with information given and the design concept expressed in the Contract Documents. The Contractor shall not be responsible for the adequacy of the performance and design criteria specified in the Contract Documents.

§ 3.13 USE OF SITE

The Contractor shall confine operations at the site to areas permitted by applicable laws, statutes, ordinances, codes, rules and regulations, and lawful orders of public authorities and the Contract Documents and shall not unreasonably encumber the site with materials or equipment.

§ 3.14 CUTTING AND PATCHING

§ 3.14.1 The Contractor shall be responsible for cutting, fitting or patching required to complete the Work or to make its parts fit together properly. All areas requiring cutting, fitting and patching shall be restored to the condition existing prior to the cutting, fitting and patching, unless otherwise required by the Contract Documents.

§ 3.14.2 The Contractor shall not damage or endanger a portion of the Work or fully or partially completed construction of the Owner or separate contractors by cutting, patching or otherwise altering such construction, or by excavation. The Contractor shall not cut or otherwise alter such construction by the Owner or a separate contractor except with written consent of the Owner and of such separate contractor; such consent shall not be unreasonably withheld. The Contractor shall not unreasonably withhold from the Owner or a separate contractor the Contractor's consent to cutting or otherwise altering the Work.

§ 3.15 CLEANING UP

§ 3.15.1 The Contractor shall keep the premises and surrounding area free from accumulation of waste materials or rubbish caused by operations under the Contract. At completion of the Work, the Contractor shall remove waste materials, rubbish, the Contractor's tools, construction equipment, machinery and surplus materials from and about the Project.

§ 3.15.2 If the Contractor fails to clean up as provided in the Contract Documents, the Owner may do so and Owner shall be entitled to reimbursement from the Contractor.

§ 3.16 ACCESS TO WORK

The Contractor shall provide the Owner and Architect access to the Work in preparation and progress wherever located.

§ 3.17 ROYALTIES, PATENTS AND COPYRIGHTS

The Contractor shall pay all royalties and license fees. The Contractor shall defend suits or claims for infringement of copyrights and patent rights and shall hold the Owner and Architect harmless from loss on account thereof, but shall not be responsible for such defense or loss when a particular design, process or product of a particular manufacturer or manufacturers is required by the Contract Documents, or where the copyright violations are contained in Drawings, Specifications or other documents prepared by the Owner or Architect. However, if the Contractor has reason to believe that the required design, process or product is an infringement of a copyright or a patent, the Contractor shall be responsible for such loss unless such information is promptly furnished to the Architect.

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§ 3.18 INDEMNIFICATION

§ 3.18.1 To the fullest extent permitted by law the Contractor shall indemnify and hold harmless the Owner, Architect, Architect's consultants, and agents and employees of any of them from and against claims, damages, losses and expenses, including but not limited to attorneys' fees, arising out of or resulting from performance of the Work, provided that such claim, damage, loss or expense is attributable to bodily injury, sickness, disease or death, or to injury to or destruction of tangible property (other than the Work itself), but only to the extent caused by the negligent acts or omissions of the Contractor, a Subcontractor, anyone directly or indirectly employed by them or anyone for whose acts they may be liable, regardless of whether or not such claim, damage, loss or expense is caused in part by a party indemnified hereunder. Such obligation shall not be construed to negate, abridge, or reduce other rights or obligations of indemnity which would otherwise exist as to a party or person described in this Section 3.18.

§ 3.18.2 In claims against any person or entity indemnified under this Section 3.18 by an employee of the Contractor, a Subcontractor, anyone directly or indirectly employed by them or anyone for whose acts they may be liable, the indemnification obligation under Section 3.18.1 shall not be limited by a limitation on amount or type of damages, compensation or benefits payable by or for the Contractor or a Subcontractor under workers' compensation acts, disability benefit acts or other employee benefit acts.

ARTICLE 4 ARCHITECT

§ 4.1 GENERAL

§ 4.1.1 The Owner shall retain an architect lawfully licensed to practice architecture or an entity lawfully practicing architecture in the jurisdiction where the Project is located. That person or entity is identified as the Architect in the Agreement and is referred to throughout the Contract Documents as if singular in number.

§ 4.1.2 Duties, responsibilities and limitations of authority of the Architect as set forth in the Contract Documents shall not be restricted, modified or extended without written consent of the Owner, Contractor and Architect. Consent shall not be unreasonably withheld.

§ 4.1.3 If the employment of the Architect is terminated, the Owner shall employ a successor architect as to whom the Contractor has no reasonable objection and whose status under the Contract Documents shall be that of the Architect.

§ 4.2 ADMINISTRATION OF THE CONTRACT

§ 4.2.1 The Architect will provide administration of the Contract as described in the Contract Documents and will be an Owner's representative during construction until the date the Architect issues the final Certificate for Payment. The Architect will have authority to act on behalf of the Owner only to the extent provided in the Contract Documents.

§ 4.2.2 The Architect will visit the site at intervals appropriate to the stage of construction, or as otherwise agreed with the Owner, to become generally familiar with the progress and quality of the portion of the Work completed, and to determine in general if the Work observed is being performed in a manner indicating that the Work, when fully completed, will be in accordance with the Contract Documents. However, the Architect will not be required to make exhaustive or continuous on-site inspections to check the quality or quantity of the Work. The Architect will not have control over, charge of, or responsibility for, the construction means, methods, techniques, sequences or procedures, or for the safety precautions and programs in connection with the Work, since these are solely the Contractor's rights and responsibilities under the Contract Documents, except as provided in Section 3.3.1.

§ 4.2.3 On the basis of the site visits, the Architect will keep the Owner reasonably informed about the progress and quality of the portion of the Work completed, and report to the Owner (1) known deviations from the Contract Documents and from the most recent construction schedule submitted by the Contractor, and (2) defects and deficiencies observed in the Work. The Architect will not be responsible for the Contractor's failure to perform the Work in accordance with the requirements of the Contract Documents. The Architect will not have control over or charge of and will not be responsible for acts or omissions of the Contractor, Subcontractors, or their agents or employees, or any other persons or entities performing portions of the Work.

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§ 4.2.4 COMMUNICATIONS FACILITATING CONTRACT ADMINISTRATION
Except as otherwise provided in the Contract Documents or when direct communications have been specially authorized, the Owner and Contractor shall endeavor to communicate with each other through the Architect about matters arising out of or relating to the Contract. Communications by and with the Architect's consultants shall be through the Architect. Communications by and with Subcontractors and material suppliers shall be through the Contractor. Communications by and with separate contractors shall be through the Owner.

§ 4.2.5 Based on the Architect's evaluations of the Contractor's Applications for Payment, the Architect will review and certify the amounts due the Contractor and will issue Certificates for Payment in such amounts.

§ 4.2.6 The Architect has authority to reject Work that does not conform to the Contract Documents. Whenever the Architect considers it necessary or advisable, the Architect will have authority to require inspection or testing of the Work in accordance with Sections 13.5.2 and 13.5.3, whether or not such Work is fabricated, installed or completed. However, neither this authority of the Architect nor a decision made in good faith either to exercise or not to exercise such authority shall give rise to a duty or responsibility of the Architect to the Contractor, Subcontractors, material and equipment suppliers, their agents or employees, or other persons or entities performing portions of the Work.

§ 4.2.7 The Architect will review and approve, or take other appropriate action upon, the Contractor's submittals such as Shop Drawings, Product Data and Samples, but only for the limited purpose of checking for conformance with information given and the design concept expressed in the Contract Documents. The Architect's action will be taken in accordance with the submittal schedule approved by the Architect or, in the absence of an approved submittal schedule, with reasonable promptness while allowing sufficient time in the Architect's professional judgment to permit adequate review. Review of such submittals is not conducted for the purpose of determining the accuracy and completeness of other details such as dimensions and quantities, or for substantiating instructions for installation or performance of equipment or systems, all of which remain the responsibility of the Contractor as required by the Contract Documents. The Architect's review of the Contractor's submittals shall not relieve the Contractor of the obligations under Sections 3.3, 3.5 and 3.12. The Architect's review shall not constitute approval of safety precautions or, unless otherwise specifically stated by the Architect, of any construction means, methods, techniques, sequences or procedures. The Architect's approval of a specific item shall not indicate approval of an assembly of which the item is a component.

§ 4.2.8 The Architect will prepare Change Orders and Construction Change Directives, and may authorize minor changes in the Work as provided in Section 7.4. The Architect will investigate and make determinations and recommendations regarding concealed and unknown conditions as provided in Section 3.7.4.

§ 4.2.9 The Architect will conduct inspections to determine the date or dates of Substantial Completion and the date of final completion; issue Certificates of Substantial Completion pursuant to Section 9.8; receive and forward to the Owner, for the Owner's review and records, written warranties and related documents required by the Contract and assembled by the Contractor pursuant to Section 9.10; and issue a final Certificate for Payment pursuant to Section 9.10.

§ 4.2.10 If the Owner and Architect agree, the Architect will provide one or more project representatives to assist in carrying out the Architect's responsibilities at the site. The duties, responsibilities and limitations of authority of such project representatives shall be as set forth in an exhibit to be incorporated in the Contract Documents.

§ 4.2.11 The Architect will interpret and decide matters concerning performance under, and requirements of, the Contract Documents on written request of either the Owner or Contractor. The Architect's response to such requests will be made in writing within any time limits agreed upon or otherwise with reasonable promptness.

§ 4.2.12 Interpretations and decisions of the Architect will be consistent with the intent of, and reasonably inferable from, the Contract Documents and will be in writing or in the form of drawings. When making such interpretations and decisions, the Architect will endeavor to secure faithful performance by both Owner and Contractor, will not show partiality to either and will not be liable for results of interpretations or decisions rendered in good faith.

§ 4.2.13 The Architect's decisions on matters relating to aesthetic effect will be final if consistent with the intent expressed in the Contract Documents.

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§ 4.2.14 The Architect will review and respond to requests for information about the Contract Documents. The Architect's response to such requests will be made in writing within any time limits agreed upon or otherwise with reasonable promptness. If appropriate, the Architect will prepare and issue supplemental Drawings and Specifications in response to the requests for information.

ARTICLE 5 SUBCONTRACTORS

§ 5.1 DEFINITIONS

§ 5.1.1 A Subcontractor is a person or entity who has a direct contract with the Contractor to perform a portion of the Work at the site. The term "Subcontractor" is referred to throughout the Contract Documents as if singular in number and means a Subcontractor or an authorized representative of the Subcontractor. The term "Subcontractor" does not include a separate contractor or subcontractors of a separate contractor.

§ 5.1.2 A Sub-subcontractor is a person or entity who has a direct or indirect contract with a Subcontractor to perform a portion of the Work at the site. The term "Sub-subcontractor" is referred to throughout the Contract Documents as if singular in number and means a Sub-subcontractor or an authorized representative of the Sub-subcontractor.

§ 5.2 AWARD OF SUBCONTRACTS AND OTHER CONTRACTS FOR PORTIONS OF THE WORK

§ 5.2.1 Unless otherwise stated in the Contract Documents or the bidding requirements, the Contractor, as soon as practicable after award of the Contract, shall furnish in writing to the Owner through the Architect the names of persons or entities (including those who are to furnish materials or equipment fabricated to a special design) proposed for each principal portion of the Work. The Architect may reply within 14 days to the Contractor in writing stating (1) whether the Owner or the Architect has reasonable objection to any such proposed person or entity or (2) that the Architect requires additional time for review. Failure of the Owner or Architect to reply within the 14 day period shall constitute notice of no reasonable objection.

§ 5.2.2 The Contractor shall not contract with a proposed person or entity to whom the Owner or Architect has made reasonable and timely objection. The Contractor shall not be required to contract with anyone to whom the Contractor has made reasonable objection.

§ 5.2.3 If the Owner or Architect has reasonable objection to a person or entity proposed by the Contractor, the Contractor shall propose another to whom the Owner or Architect has no reasonable objection. If the proposed but rejected Subcontractor was reasonably capable of performing the Work, the Contract Sum and Contract Time shall be increased or decreased by the difference, if any, occasioned by such change, and an appropriate Change Order shall be issued before commencement of the substitute Subcontractor's Work. However, no increase in the Contract Sum or Contract Time shall be allowed for such change unless the Contractor has acted promptly and responsively in submitting names as required.

§ 5.2.4 The Contractor shall not substitute a Subcontractor, person or entity previously selected if the Owner or Architect makes reasonable objection to such substitution.

§ 5.3 SUBCONTRACTUAL RELATIONS

By appropriate agreement, written where legally required for validity, the Contractor shall require each Subcontractor, to the extent of the Work to be performed by the Subcontractor, to be bound to the Contractor by terms of the Contract Documents, and to assume toward the Contractor all the obligations and responsibilities, including the responsibility for safety of the Subcontractor's Work, which the Contractor, by these Documents, assumes toward the Owner and Architect. Each subcontract agreement shall preserve and protect the rights of the Owner and Architect under the Contract Documents with respect to the Work to be performed by the Subcontractor so that subcontracting thereof will not prejudice such rights, and shall allow to the Subcontractor, unless specifically provided otherwise in the subcontract agreement, the benefit of all rights, remedies and redress against the Contractor that the Contractor, by the Contract Documents, has against the Owner. Where appropriate, the Contractor shall require each Subcontractor to enter into similar agreements with Sub-subcontractors. The Contractor shall make available to each proposed Subcontractor, prior to the execution of the subcontract agreement, copies of the Contract Documents to which the Subcontractor will be bound, and, upon written request of the Subcontractor, identify to the Subcontractor terms and conditions of the proposed subcontract agreement that may

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be at variance with the Contract Documents. Subcontractors will similarly make copies of applicable portions of such documents available to their respective proposed Sub-subcontractors.

§ 5.4 CONTINGENT ASSIGNMENT OF SUBCONTRACTS

§ 5.4.1 Each subcontract agreement for a portion of the Work is assigned by the Contractor to the Owner, provided that

- **.1** assignment is effective only after termination of the Contract by the Owner for cause pursuant to Section 14.2 and only for those subcontract agreements that the Owner accepts by notifying the Subcontractor and Contractor in writing; and
- **.2** assignment is subject to the prior rights of the surety, if any, obligated under bond relating to the Contract.

When the Owner accepts the assignment of a subcontract agreement, the Owner assumes the Contractor's rights and obligations under the subcontract.

§ 5.4.2 Upon such assignment, if the Work has been suspended for more than 30 days, the Subcontractor's compensation shall be equitably adjusted for increases in cost resulting from the suspension.

§ 5.4.3 Upon such assignment to the Owner under this Section 5.4, the Owner may further assign the subcontract to a successor contractor or other entity. If the Owner assigns the subcontract to a successor contractor or other entity, the Owner shall nevertheless remain legally responsible for all of the successor contractor's obligations under the subcontract.

ARTICLE 6 CONSTRUCTION BY OWNER OR BY SEPARATE CONTRACTORS

§ 6.1 OWNER'S RIGHT TO PERFORM CONSTRUCTION AND TO AWARD SEPARATE CONTRACTS

§ 6.1.1 The Owner reserves the right to perform construction or operations related to the Project with the Owner's own forces, and to award separate contracts in connection with other portions of the Project or other construction or operations on the site under Conditions of the Contract identical or substantially similar to these including those portions related to insurance and waiver of subrogation. If the Contractor claims that delay or additional cost is involved because of such action by the Owner, the Contractor shall make such Claim as provided in Article 15.

§ 6.1.2 When separate contracts are awarded for different portions of the Project or other construction or operations on the site, the term "Contractor" in the Contract Documents in each case shall mean the Contractor who executes each separate Owner-Contractor Agreement.

§ 6.1.3 The Owner shall provide for coordination of the activities of the Owner's own forces and of each separate contractor with the Work of the Contractor, who shall cooperate with them. The Contractor shall participate with other separate contractors and the Owner in reviewing their construction schedules. The Contractor shall make any revisions to the construction schedule deemed necessary after a joint review and mutual agreement. The construction schedules shall then constitute the schedules to be used by the Contractor, separate contractors and the Owner until subsequently revised.

§ 6.1.4 Unless otherwise provided in the Contract Documents, when the Owner performs construction or operations related to the Project with the Owner's own forces, the Owner shall be deemed to be subject to the same obligations and to have the same rights that apply to the Contractor under the Conditions of the Contract, including, without excluding others, those stated in Article 3, this Article 6 and Articles 10, 11 and 12.

§ 6.2 MUTUAL RESPONSIBILITY

§ 6.2.1 The Contractor shall afford the Owner and separate contractors reasonable opportunity for introduction and storage of their materials and equipment and performance of their activities, and shall connect and coordinate the Contractor's construction and operations with theirs as required by the Contract Documents.

§ 6.2.2 If part of the Contractor's Work depends for proper execution or results upon construction or operations by the Owner or a separate contractor, the Contractor shall, prior to proceeding with that portion of the Work, promptly report to the Architect apparent discrepancies or defects in such other construction that would render it unsuitable for such proper execution and results. Failure of the Contractor so to report shall constitute an acknowledgment that

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the Owner's or separate contractor's completed or partially completed construction is fit and proper to receive the Contractor's Work, except as to defects not then reasonably discoverable.

§ 6.2.3 The Contractor shall reimburse the Owner for costs the Owner incurs that are payable to a separate contractor because of the Contractor's delays, improperly timed activities or defective construction. The Owner shall be responsible to the Contractor for costs the Contractor incurs because of a separate contractor's delays, improperly timed activities, damage to the Work or defective construction.

§ 6.2.4 The Contractor shall promptly remedy damage the Contractor wrongfully causes to completed or partially completed construction or to property of the Owner or separate contractors as provided in Section 10.2.5.

§ 6.2.5 The Owner and each separate contractor shall have the same responsibilities for cutting and patching as are described for the Contractor in Section 3.14.

§ 6.3 OWNER'S RIGHT TO CLEAN UP

If a dispute arises among the Contractor, separate contractors and the Owner as to the responsibility under their respective contracts for maintaining the premises and surrounding area free from waste materials and rubbish, the Owner may clean up and the Architect will allocate the cost among those responsible.

ARTICLE 7 CHANGES IN THE WORK

§ 7.1 GENERAL

§ 7.1.1 Changes in the Work may be accomplished after execution of the Contract, and without invalidating the Contract, by Change Order, Construction Change Directive or order for a minor change in the Work, subject to the limitations stated in this Article 7 and elsewhere in the Contract Documents.

§ 7.1.2 A Change Order shall be based upon agreement among the Owner, Contractor and Architect; a Construction Change Directive requires agreement by the Owner and Architect and may or may not be agreed to by the Contractor; an order for a minor change in the Work may be issued by the Architect alone.

§ 7.1.3 Changes in the Work shall be performed under applicable provisions of the Contract Documents, and the Contractor shall proceed promptly, unless otherwise provided in the Change Order, Construction Change Directive or order for a minor change in the Work.

§ 7.2 CHANGE ORDERS

§ 7.2.1 A Change Order is a written instrument prepared by the Architect and signed by the Owner, Contractor and Architect stating their agreement upon all of the following:

- **.1** The change in the Work;
- **.2** The amount of the adjustment, if any, in the Contract Sum; and
- **.3** The extent of the adjustment, if any, in the Contract Time.

§ 7.3 CONSTRUCTION CHANGE DIRECTIVES

§ 7.3.1 A Construction Change Directive is a written order prepared by the Architect and signed by the Owner and Architect, directing a change in the Work prior to agreement on adjustment, if any, in the Contract Sum or Contract Time, or both. The Owner may by Construction Change Directive, without invalidating the Contract, order changes in the Work within the general scope of the Contract consisting of additions, deletions or other revisions, the Contract Sum and Contract Time being adjusted accordingly.

§ 7.3.2 A Construction Change Directive shall be used in the absence of total agreement on the terms of a Change Order.

§ 7.3.3 If the Construction Change Directive provides for an adjustment to the Contract Sum, the adjustment shall be based on one of the following methods:

- **.1** Mutual acceptance of a lump sum properly itemized and supported by sufficient substantiating data to permit evaluation;
- **.2** Unit prices stated in the Contract Documents or subsequently agreed upon;
- **.3** Cost to be determined in a manner agreed upon by the parties and a mutually acceptable fixed or percentage fee; or

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.4 As provided in Section 7.3.7.

§ 7.3.4 If unit prices are stated in the Contract Documents or subsequently agreed upon, and if quantities originally contemplated are materially changed in a proposed Change Order or Construction Change Directive so that application of such unit prices to quantities of Work proposed will cause substantial inequity to the Owner or Contractor, the applicable unit prices shall be equitably adjusted.

§ 7.3.5 Upon receipt of a Construction Change Directive, the Contractor shall promptly proceed with the change in the Work involved and advise the Architect of the Contractor's agreement or disagreement with the method, if any, provided in the Construction Change Directive for determining the proposed adjustment in the Contract Sum or Contract Time.

§ 7.3.6 A Construction Change Directive signed by the Contractor indicates the Contractor's agreement therewith, including adjustment in Contract Sum and Contract Time or the method for determining them. Such agreement shall be effective immediately and shall be recorded as a Change Order.

§ 7.3.7 If the Contractor does not respond promptly or disagrees with the method for adjustment in the Contract Sum, the Architect shall determine the method and the adjustment on the basis of reasonable expenditures and savings of those performing the Work attributable to the change, including, in case of an increase in the Contract Sum, an amount for overhead and profit as set forth in the Agreement, or if no such amount is set forth in the Agreement, a reasonable amount. In such case, and also under Section 7.3.3.3, the Contractor shall keep and present, in such form as the Architect may prescribe, an itemized accounting together with appropriate supporting data. Unless otherwise provided in the Contract Documents, costs for the purposes of this Section 7.3.7 shall be limited to the following:

.1 Costs of labor, including social security, old age and unemployment insurance, fringe benefits required by agreement or custom, and workers' compensation insurance;

.2 Costs of materials, supplies and equipment, including cost of transportation, whether incorporated or consumed;

.3 Rental costs of machinery and equipment, exclusive of hand tools, whether rented from the Contractor or others;

.4 Costs of premiums for all bonds and insurance, permit fees, and sales, use or similar taxes related to the Work; and

.5 Additional costs of supervision and field office personnel directly attributable to the change.

§ 7.3.8 The amount of credit to be allowed by the Contractor to the Owner for a deletion or change that results in a net decrease in the Contract Sum shall be actual net cost as confirmed by the Architect. When both additions and credits covering related Work or substitutions are involved in a change, the allowance for overhead and profit shall be figured on the basis of net increase, if any, with respect to that change.

§ 7.3.9 Pending final determination of the total cost of a Construction Change Directive to the Owner, the Contractor may request payment for Work completed under the Construction Change Directive in Applications for Payment. The Architect will make an interim determination for purposes of monthly certification for payment for those costs and certify for payment the amount that the Architect determines, in the Architect's professional judgment, to be reasonably justified. The Architect's interim determination of cost shall adjust the Contract Sum on the same basis as a Change Order, subject to the right of either party to disagree and assert a Claim in accordance with Article 15.

§ 7.3.10 When the Owner and Contractor agree with a determination made by the Architect concerning the adjustments in the Contract Sum and Contract Time, or otherwise reach agreement upon the adjustments, such agreement shall be effective immediately and the Architect will prepare a Change Order. Change Orders may be issued for all or any part of a Construction Change Directive.

§ 7.4 MINOR CHANGES IN THE WORK

The Architect has authority to order minor changes in the Work not involving adjustment in the Contract Sum or extension of the Contract Time and not inconsistent with the intent of the Contract Documents. Such changes will be effected by written order signed by the Architect and shall be binding on the Owner and Contractor.

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ARTICLE 8 TIME

§ 8.1 DEFINITIONS

§ 8.1.1 Unless otherwise provided, Contract Time is the period of time, including authorized adjustments, allotted in the Contract Documents for Substantial Completion of the Work.

§ 8.1.2 The date of commencement of the Work is the date established in the Agreement.

§ 8.1.3 The date of Substantial Completion is the date certified by the Architect in accordance with Section 9.8.

§ 8.1.4 The term "day" as used in the Contract Documents shall mean calendar day unless otherwise specifically defined.

§ 8.2 PROGRESS AND COMPLETION

§ 8.2.1 Time limits stated in the Contract Documents are of the essence of the Contract. By executing the Agreement the Contractor confirms that the Contract Time is a reasonable period for performing the Work.

§ 8.2.2 The Contractor shall not knowingly, except by agreement or instruction of the Owner in writing, prematurely commence operations on the site or elsewhere prior to the effective date of insurance required by Article 11 to be furnished by the Contractor and Owner. The date of commencement of the Work shall not be changed by the effective date of such insurance.

§ 8.2.3 The Contractor shall proceed expeditiously with adequate forces and shall achieve Substantial Completion within the Contract Time.

§ 8.3 DELAYS AND EXTENSIONS OF TIME

§ 8.3.1 If the Contractor is delayed at any time in the commencement or progress of the Work by an act or neglect of the Owner or Architect, or of an employee of either, or of a separate contractor employed by the Owner; or by changes ordered in the Work; or by labor disputes, fire, unusual delay in deliveries, unavoidable casualties or other causes beyond the Contractor's control; or by delay authorized by the Owner pending mediation and arbitration; or by other causes that the Architect determines may justify delay, then the Contract Time shall be extended by Change Order for such reasonable time as the Architect may determine.

§ 8.3.2 Claims relating to time shall be made in accordance with applicable provisions of Article 15.

§ 8.3.3 This Section 8.3 does not preclude recovery of damages for delay by either party under other provisions of the Contract Documents.

ARTICLE 9 PAYMENTS AND COMPLETION

§ 9.1 CONTRACT SUM

The Contract Sum is stated in the Agreement and, including authorized adjustments, is the total amount payable by the Owner to the Contractor for performance of the Work under the Contract Documents.

§ 9.2 SCHEDULE OF VALUES

Where the Contract is based on a stipulated sum or Guaranteed Maximum Price, the Contractor shall submit to the Architect, before the first Application for Payment, a schedule of values allocating the entire Contract Sum to the various portions of the Work and prepared in such form and supported by such data to substantiate its accuracy as the Architect may require. This schedule, unless objected to by the Architect, shall be used as a basis for reviewing the Contractor's Applications for Payment.

§ 9.3 APPLICATIONS FOR PAYMENT

§ 9.3.1 At least ten days before the date established for each progress payment, the Contractor shall submit to the Architect an itemized Application for Payment prepared in accordance with the schedule of values, if required under Section 9.2, for completed portions of the Work. Such application shall be notarized, if required, and supported by such data substantiating the Contractor's right to payment as the Owner or Architect may require, such as copies of requisitions from Subcontractors and material suppliers, and shall reflect retainage if provided for in the Contract Documents.

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§ 9.3.1.1 As provided in Section 7.3.9, such applications may include requests for payment on account of changes in the Work that have been properly authorized by Construction Change Directives, or by interim determinations of the Architect, but not yet included in Change Orders.

§ 9.3.1.2 Applications for Payment shall not include requests for payment for portions of the Work for which the Contractor does not intend to pay a Subcontractor or material supplier, unless such Work has been performed by others whom the Contractor intends to pay.

§ 9.3.2 Unless otherwise provided in the Contract Documents, payments shall be made on account of materials and equipment delivered and suitably stored at the site for subsequent incorporation in the Work. If approved in advance by the Owner, payment may similarly be made for materials and equipment suitably stored off the site at a location agreed upon in writing. Payment for materials and equipment stored on or off the site shall be conditioned upon compliance by the Contractor with procedures satisfactory to the Owner to establish the Owner's title to such materials and equipment or otherwise protect the Owner's interest, and shall include the costs of applicable insurance, storage and transportation to the site for such materials and equipment stored off the site.

§ 9.3.3 The Contractor warrants that title to all Work covered by an Application for Payment will pass to the Owner no later than the time of payment. The Contractor further warrants that upon submittal of an Application for Payment all Work for which Certificates for Payment have been previously issued and payments received from the Owner shall, to the best of the Contractor's knowledge, information and belief, be free and clear of liens, claims, security interests or encumbrances in favor of the Contractor, Subcontractors, material suppliers, or other persons or entities making a claim by reason of having provided labor, materials and equipment relating to the Work.

§ 9.4 CERTIFICATES FOR PAYMENT

§ 9.4.1 The Architect will, within seven days after receipt of the Contractor's Application for Payment, either issue to the Owner a Certificate for Payment, with a copy to the Contractor, for such amount as the Architect determines is properly due, or notify the Contractor and Owner in writing of the Architect's reasons for withholding certification in whole or in part as provided in Section 9.5.1.

§ 9.4.2 The issuance of a Certificate for Payment will constitute a representation by the Architect to the Owner, based on the Architect's evaluation of the Work and the data comprising the Application for Payment, that, to the best of the Architect's knowledge, information and belief, the Work has progressed to the point indicated and that the quality of the Work is in accordance with the Contract Documents. The foregoing representations are subject to an evaluation of the Work for conformance with the Contract Documents upon Substantial Completion, to results of subsequent tests and inspections, to correction of minor deviations from the Contract Documents prior to completion and to specific qualifications expressed by the Architect. The issuance of a Certificate for Payment will further constitute a representation that the Contractor is entitled to payment in the amount certified. However, the issuance of a Certificate for Payment will not be a representation that the Architect has (1) made exhaustive or continuous on-site inspections to check the quality or quantity of the Work, (2) reviewed construction means, methods, techniques, sequences or procedures, (3) reviewed copies of requisitions received from Subcontractors and material suppliers and other data requested by the Owner to substantiate the Contractor's right to payment, or (4) made examination to ascertain how or for what purpose the Contractor has used money previously paid on account of the Contract Sum.

§ 9.5 DECISIONS TO WITHHOLD CERTIFICATION

§ 9.5.1 The Architect may withhold a Certificate for Payment in whole or in part, to the extent reasonably necessary to protect the Owner, if in the Architect's opinion the representations to the Owner required by Section 9.4.2 cannot be made. If the Architect is unable to certify payment in the amount of the Application, the Architect will notify the Contractor and Owner as provided in Section 9.4.1. If the Contractor and Architect cannot agree on a revised amount, the Architect will promptly issue a Certificate for Payment for the amount for which the Architect is able to make such representations to the Owner. The Architect may also withhold a Certificate for Payment or, because of subsequently discovered evidence, may nullify the whole or a part of a Certificate for Payment previously issued, to such extent as may be necessary in the Architect's opinion to protect the Owner from loss for which the Contractor is responsible, including loss resulting from acts and omissions described in Section 3.3.2, because of

.1 defective Work not remedied;

.2 third party claims filed or reasonable evidence indicating probable filing of such claims unless security acceptable to the Owner is provided by the Contractor;

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.3 failure of the Contractor to make payments properly to Subcontractors or for labor, materials or equipment;
.4 reasonable evidence that the Work cannot be completed for the unpaid balance of the Contract Sum;
.5 damage to the Owner or a separate contractor;
.6 reasonable evidence that the Work will not be completed within the Contract Time, and that the unpaid balance would not be adequate to cover actual or liquidated damages for the anticipated delay; or
.7 repeated failure to carry out the Work in accordance with the Contract Documents.

§ 9.5.2 When the above reasons for withholding certification are removed, certification will be made for amounts previously withheld.

§ 9.5.3 If the Architect withholds certification for payment under Section 9.5.1.3, the Owner may, at its sole option, issue joint checks to the Contractor and to any Subcontractor or material or equipment suppliers to whom the Contractor failed to make payment for Work properly performed or material or equipment suitably delivered. If the Owner makes payments by joint check, the Owner shall notify the Architect and the Architect will reflect such payment on the next Certificate for Payment.

§ 9.6 PROGRESS PAYMENTS

§ 9.6.1 After the Architect has issued a Certificate for Payment, the Owner shall make payment in the manner and within the time provided in the Contract Documents, and shall so notify the Architect.

§ 9.6.2 The Contractor shall pay each Subcontractor no later than seven days after receipt of payment from the Owner the amount to which the Subcontractor is entitled, reflecting percentages actually retained from payments to the Contractor on account of the Subcontractor's portion of the Work. The Contractor shall, by appropriate agreement with each Subcontractor, require each Subcontractor to make payments to Sub-subcontractors in a similar manner.

§ 9.6.3 The Architect will, on request, furnish to a Subcontractor, if practicable, information regarding percentages of completion or amounts applied for by the Contractor and action taken thereon by the Architect and Owner on account of portions of the Work done by such Subcontractor.

§ 9.6.4 The Owner has the right to request written evidence from the Contractor that the Contractor has properly paid Subcontractors and material and equipment suppliers amounts paid by the Owner to the Contractor for subcontracted Work. If the Contractor fails to furnish such evidence within seven days, the Owner shall have the right to contact Subcontractors to ascertain whether they have been properly paid. Neither the Owner nor Architect shall have an obligation to pay or to see to the payment of money to a Subcontractor, except as may otherwise be required by law.

§ 9.6.5 Contractor payments to material and equipment suppliers shall be treated in a manner similar to that provided in Sections 9.6.2, 9.6.3 and 9.6.4.

§ 9.6.6 A Certificate for Payment, a progress payment, or partial or entire use or occupancy of the Project by the Owner shall not constitute acceptance of Work not in accordance with the Contract Documents.

§ 9.6.7 Unless the Contractor provides the Owner with a payment bond in the full penal sum of the Contract Sum, payments received by the Contractor for Work properly performed by Subcontractors and suppliers shall be held by the Contractor for those Subcontractors or suppliers who performed Work or furnished materials, or both, under contract with the Contractor for which payment was made by the Owner. Nothing contained herein shall require money to be placed in a separate account and not commingled with money of the Contractor, shall create any fiduciary liability or tort liability on the part of the Contractor for breach of trust or shall entitle any person or entity to an award of punitive damages against the Contractor for breach of the requirements of this provision.

§ 9.7 FAILURE OF PAYMENT

If the Architect does not issue a Certificate for Payment, through no fault of the Contractor, within seven days after receipt of the Contractor's Application for Payment, or if the Owner does not pay the Contractor within seven days after the date established in the Contract Documents the amount certified by the Architect or awarded by binding dispute resolution, then the Contractor may, upon seven additional days' written notice to the Owner and Architect,

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stop the Work until payment of the amount owing has been received. The Contract Time shall be extended appropriately and the Contract Sum shall be increased by the amount of the Contractor's reasonable costs of shut-down, delay and start-up, plus interest as provided for in the Contract Documents.

§ 9.8 SUBSTANTIAL COMPLETION

§ 9.8.1 Substantial Completion is the stage in the progress of the Work when the Work or designated portion thereof is sufficiently complete in accordance with the Contract Documents so that the Owner can occupy or utilize the Work for its intended use.

§ 9.8.2 When the Contractor considers that the Work, or a portion thereof which the Owner agrees to accept separately, is substantially complete, the Contractor shall prepare and submit to the Architect a comprehensive list of items to be completed or corrected prior to final payment. Failure to include an item on such list does not alter the responsibility of the Contractor to complete all Work in accordance with the Contract Documents.

§ 9.8.3 Upon receipt of the Contractor's list, the Architect will make an inspection to determine whether the Work or designated portion thereof is substantially complete. If the Architect's inspection discloses any item, whether or not included on the Contractor's list, which is not sufficiently complete in accordance with the Contract Documents so that the Owner can occupy or utilize the Work or designated portion thereof for its intended use, the Contractor shall, before issuance of the Certificate of Substantial Completion, complete or correct such item upon notification by the Architect. In such case, the Contractor shall then submit a request for another inspection by the Architect to determine Substantial Completion.

§ 9.8.4 When the Work or designated portion thereof is substantially complete, the Architect will prepare a Certificate of Substantial Completion that shall establish the date of Substantial Completion, shall establish responsibilities of the Owner and Contractor for security, maintenance, heat, utilities, damage to the Work and insurance, and shall fix the time within which the Contractor shall finish all items on the list accompanying the Certificate. Warranties required by the Contract Documents shall commence on the date of Substantial Completion of the Work or designated portion thereof unless otherwise provided in the Certificate of Substantial Completion.

§ 9.8.5 The Certificate of Substantial Completion shall be submitted to the Owner and Contractor for their written acceptance of responsibilities assigned to them in such Certificate. Upon such acceptance and consent of surety, if any, the Owner shall make payment of retainage applying to such Work or designated portion thereof. Such payment shall be adjusted for Work that is incomplete or not in accordance with the requirements of the Contract Documents.

§ 9.9 PARTIAL OCCUPANCY OR USE

§ 9.9.1 The Owner may occupy or use any completed or partially completed portion of the Work at any stage when such portion is designated by separate agreement with the Contractor, provided such occupancy or use is consented to by the insurer as required under Section 11.3.1.5 and authorized by public authorities having jurisdiction over the Project. Such partial occupancy or use may commence whether or not the portion is substantially complete, provided the Owner and Contractor have accepted in writing the responsibilities assigned to each of them for payments, retainage, if any, security, maintenance, heat, utilities, damage to the Work and insurance, and have agreed in writing concerning the period for correction of the Work and commencement of warranties required by the Contract Documents. When the Contractor considers a portion substantially complete, the Contractor shall prepare and submit a list to the Architect as provided under Section 9.8.2. Consent of the Contractor to partial occupancy or use shall not be unreasonably withheld. The stage of the progress of the Work shall be determined by written agreement between the Owner and Contractor or, if no agreement is reached, by decision of the Architect.

§ 9.9.2 Immediately prior to such partial occupancy or use, the Owner, Contractor and Architect shall jointly inspect the area to be occupied or portion of the Work to be used in order to determine and record the condition of the Work.

§ 9.9.3 Unless otherwise agreed upon, partial occupancy or use of a portion or portions of the Work shall not constitute acceptance of Work not complying with the requirements of the Contract Documents.

§ 9.10 FINAL COMPLETION AND FINAL PAYMENT

§ 9.10.1 Upon receipt of the Contractor's written notice that the Work is ready for final inspection and acceptance and upon receipt of a final Application for Payment, the Architect will promptly make such inspection and, when the

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Architect finds the Work acceptable under the Contract Documents and the Contract fully performed, the Architect will promptly issue a final Certificate for Payment stating that to the best of the Architect's knowledge, information and belief, and on the basis of the Architect's on-site visits and inspections, the Work has been completed in accordance with terms and conditions of the Contract Documents and that the entire balance found to be due the Contractor and noted in the final Certificate is due and payable. The Architect's final Certificate for Payment will constitute a further representation that conditions listed in Section 9.10.2 as precedent to the Contractor's being entitled to final payment have been fulfilled.

§ 9.10.2 Neither final payment nor any remaining retained percentage shall become due until the Contractor submits to the Architect (1) an affidavit that payrolls, bills for materials and equipment, and other indebtedness connected with the Work for which the Owner or the Owner's property might be responsible or encumbered (less amounts withheld by Owner) have been paid or otherwise satisfied, (2) a certificate evidencing that insurance required by the Contract Documents to remain in force after final payment is currently in effect and will not be canceled or allowed to expire until at least 30 days' prior written notice has been given to the Owner, (3) a written statement that the Contractor knows of no substantial reason that the insurance will not be renewable to cover the period required by the Contract Documents, (4) consent of surety, if any, to final payment and (5), if required by the Owner, other data establishing payment or satisfaction of obligations, such as receipts, releases and waivers of liens, claims, security interests or encumbrances arising out of the Contract, to the extent and in such form as may be designated by the Owner. If a Subcontractor refuses to furnish a release or waiver required by the Owner, the Contractor may furnish a bond satisfactory to the Owner to indemnify the Owner against such lien. If such lien remains unsatisfied after payments are made, the Contractor shall refund to the Owner all money that the Owner may be compelled to pay in discharging such lien, including all costs and reasonable attorneys' fees.

§ 9.10.3 If, after Substantial Completion of the Work, final completion thereof is materially delayed through no fault of the Contractor or by issuance of Change Orders affecting final completion, and the Architect so confirms, the Owner shall, upon application by the Contractor and certification by the Architect, and without terminating the Contract, make payment of the balance due for that portion of the Work fully completed and accepted. If the remaining balance for Work not fully completed or corrected is less than retainage stipulated in the Contract Documents, and if bonds have been furnished, the written consent of surety to payment of the balance due for that portion of the Work fully completed and accepted shall be submitted by the Contractor to the Architect prior to certification of such payment. Such payment shall be made under terms and conditions governing final payment, except that it shall not constitute a waiver of claims.

§ 9.10.4 The making of final payment shall constitute a waiver of Claims by the Owner except those arising from

- **.1** liens, Claims, security interests or encumbrances arising out of the Contract and unsettled;
- **.2** failure of the Work to comply with the requirements of the Contract Documents; or
- **.3** terms of special warranties required by the Contract Documents.

§ 9.10.5 Acceptance of final payment by the Contractor, a Subcontractor or material supplier shall constitute a waiver of claims by that payee except those previously made in writing and identified by that payee as unsettled at the time of final Application for Payment.

ARTICLE 10 PROTECTION OF PERSONS AND PROPERTY

§ 10.1 SAFETY PRECAUTIONS AND PROGRAMS

The Contractor shall be responsible for initiating, maintaining and supervising all safety precautions and programs in connection with the performance of the Contract.

§ 10.2 SAFETY OF PERSONS AND PROPERTY

§ 10.2.1 The Contractor shall take reasonable precautions for safety of, and shall provide reasonable protection to prevent damage, injury or loss to

- **.1** employees on the Work and other persons who may be affected thereby;
- **.2** the Work and materials and equipment to be incorporated therein, whether in storage on or off the site, under care, custody or control of the Contractor or the Contractor's Subcontractors or Sub-subcontractors; and
- **.3** other property at the site or adjacent thereto, such as trees, shrubs, lawns, walks, pavements, roadways, structures and utilities not designated for removal, relocation or replacement in the course of construction.

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§ 10.2.2 The Contractor shall comply with and give notices required by applicable laws, statutes, ordinances, codes, rules and regulations, and lawful orders of public authorities bearing on safety of persons or property or their protection from damage, injury or loss.

§ 10.2.3 The Contractor shall erect and maintain, as required by existing conditions and performance of the Contract, reasonable safeguards for safety and protection, including posting danger signs and other warnings against hazards, promulgating safety regulations and notifying owners and users of adjacent sites and utilities.

§ 10.2.4 When use or storage of explosives or other hazardous materials or equipment or unusual methods are necessary for execution of the Work, the Contractor shall exercise utmost care and carry on such activities under supervision of properly qualified personnel.

§ 10.2.5 The Contractor shall promptly remedy damage and loss (other than damage or loss insured under property insurance required by the Contract Documents) to property referred to in Sections 10.2.1.2 and 10.2.1.3 caused in whole or in part by the Contractor, a Subcontractor, a Sub-subcontractor, or anyone directly or indirectly employed by any of them, or by anyone for whose acts they may be liable and for which the Contractor is responsible under Sections 10.2.1.2 and 10.2.1.3, except damage or loss attributable to acts or omissions of the Owner or Architect or anyone directly or indirectly employed by either of them, or by anyone for whose acts either of them may be liable, and not attributable to the fault or negligence of the Contractor. The foregoing obligations of the Contractor are in addition to the Contractor's obligations under Section 3.18.

§ 10.2.6 The Contractor shall designate a responsible member of the Contractor's organization at the site whose duty shall be the prevention of accidents. This person shall be the Contractor's superintendent unless otherwise designated by the Contractor in writing to the Owner and Architect.

§ 10.2.7 The Contractor shall not permit any part of the construction or site to be loaded so as to cause damage or create an unsafe condition.

§ 10.2.8 INJURY OR DAMAGE TO PERSON OR PROPERTY
If either party suffers injury or damage to person or property because of an act or omission of the other party, or of others for whose acts such party is legally responsible, written notice of such injury or damage, whether or not insured, shall be given to the other party within a reasonable time not exceeding 21 days after discovery. The notice shall provide sufficient detail to enable the other party to investigate the matter.

§ 10.3 HAZARDOUS MATERIALS
§ 10.3.1 The Contractor is responsible for compliance with any requirements included in the Contract Documents regarding hazardous materials. If the Contractor encounters a hazardous material or substance not addressed in the Contract Documents and if reasonable precautions will be inadequate to prevent foreseeable bodily injury or death to persons resulting from a material or substance, including but not limited to asbestos or polychlorinated biphenyl (PCB), encountered on the site by the Contractor, the Contractor shall, upon recognizing the condition, immediately stop Work in the affected area and report the condition to the Owner and Architect in writing.

§ 10.3.2 Upon receipt of the Contractor's written notice, the Owner shall obtain the services of a licensed laboratory to verify the presence or absence of the material or substance reported by the Contractor and, in the event such material or substance is found to be present, to cause it to be rendered harmless. Unless otherwise required by the Contract Documents, the Owner shall furnish in writing to the Contractor and Architect the names and qualifications of persons or entities who are to perform tests verifying the presence or absence of such material or substance or who are to perform the task of removal or safe containment of such material or substance. The Contractor and the Architect will promptly reply to the Owner in writing stating whether or not either has reasonable objection to the persons or entities proposed by the Owner. If either the Contractor or Architect has an objection to a person or entity proposed by the Owner, the Owner shall propose another to whom the Contractor and the Architect have no reasonable objection. When the material or substance has been rendered harmless, Work in the affected area shall resume upon written agreement of the Owner and Contractor. By Change Order, the Contract Time shall be extended appropriately and the Contract Sum shall be increased in the amount of the Contractor's reasonable additional costs of shut-down, delay and start-up.

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§ 10.3.3 To the fullest extent permitted by law, the Owner shall indemnify and hold harmless the Contractor, Subcontractors, Architect, Architect's consultants and agents and employees of any of them from and against claims, damages, losses and expenses, including but not limited to attorneys' fees, arising out of or resulting from performance of the Work in the affected area if in fact the material or substance presents the risk of bodily injury or death as described in Section 10.3.1 and has not been rendered harmless, provided that such claim, damage, loss or expense is attributable to bodily injury, sickness, disease or death, or to injury to or destruction of tangible property (other than the Work itself), except to the extent that such damage, loss or expense is due to the fault or negligence of the party seeking indemnity.

§ 10.3.4 The Owner shall not be responsible under this Section 10.3 for materials or substances the Contractor brings to the site unless such materials or substances are required by the Contract Documents. The Owner shall be responsible for materials or substances required by the Contract Documents, except to the extent of the Contractor's fault or negligence in the use and handling of such materials or substances.

§ 10.3.5 The Contractor shall indemnify the Owner for the cost and expense the Owner incurs (1) for remediation of a material or substance the Contractor brings to the site and negligently handles, or (2) where the Contractor fails to perform its obligations under Section 10.3.1, except to the extent that the cost and expense are due to the Owner's fault or negligence.

§ 10.3.6 If, without negligence on the part of the Contractor, the Contractor is held liable by a government agency for the cost of remediation of a hazardous material or substance solely by reason of performing Work as required by the Contract Documents, the Owner shall indemnify the Contractor for all cost and expense thereby incurred.

§ 10.4 EMERGENCIES

In an emergency affecting safety of persons or property, the Contractor shall act, at the Contractor's discretion, to prevent threatened damage, injury or loss. Additional compensation or extension of time claimed by the Contractor on account of an emergency shall be determined as provided in Article 15 and Article 7.

ARTICLE 11 INSURANCE AND BONDS

§ 11.1 CONTRACTOR'S LIABILITY INSURANCE

§ 11.1.1 The Contractor shall purchase from and maintain in a company or companies lawfully authorized to do business in the jurisdiction in which the Project is located such insurance as will protect the Contractor from claims set forth below which may arise out of or result from the Contractor's operations and completed operations under the Contract and for which the Contractor may be legally liable, whether such operations be by the Contractor or by a Subcontractor or by anyone directly or indirectly employed by any of them, or by anyone for whose acts any of them may be liable:

- **.1** Claims under workers' compensation, disability benefit and other similar employee benefit acts that are applicable to the Work to be performed;
- **.2** Claims for damages because of bodily injury, occupational sickness or disease, or death of the Contractor's employees;
- **.3** Claims for damages because of bodily injury, sickness or disease, or death of any person other than the Contractor's employees;
- **.4** Claims for damages insured by usual personal injury liability coverage;
- **.5** Claims for damages, other than to the Work itself, because of injury to or destruction of tangible property, including loss of use resulting therefrom;
- **.6** Claims for damages because of bodily injury, death of a person or property damage arising out of ownership, maintenance or use of a motor vehicle;
- **.7** Claims for bodily injury or property damage arising out of completed operations; and
- **.8** Claims involving contractual liability insurance applicable to the Contractor's obligations under Section 3.18.

§ 11.1.2 The insurance required by Section 11.1.1 shall be written for not less than limits of liability specified in the Contract Documents or required by law, whichever coverage is greater. Coverages, whether written on an occurrence or claims-made basis, shall be maintained without interruption from the date of commencement of the Work until the date of final payment and termination of any coverage required to be maintained after final payment, and, with respect to the Contractor's completed operations coverage, until the expiration of the period for correction

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of Work or for such other period for maintenance of completed operations coverage as specified in the Contract Documents.

§ 11.1.3 Certificates of insurance acceptable to the Owner shall be filed with the Owner prior to commencement of the Work and thereafter upon renewal or replacement of each required policy of insurance. These certificates and the insurance policies required by this Section 11.1 shall contain a provision that coverages afforded under the policies will not be canceled or allowed to expire until at least 30 days' prior written notice has been given to the Owner. An additional certificate evidencing continuation of liability coverage, including coverage for completed operations, shall be submitted with the final Application for Payment as required by Section 9.10.2 and thereafter upon renewal or replacement of such coverage until the expiration of the time required by Section 11.1.2. Information concerning reduction of coverage on account of revised limits or claims paid under the General Aggregate, or both, shall be furnished by the Contractor with reasonable promptness.

§ 11.1.4 The Contractor shall cause the commercial liability coverage required by the Contract Documents to include (1) the Owner, the Architect and the Architect's consultants as additional insureds for claims caused in whole or in part by the Contractor's negligent acts or omissions during the Contractor's operations; and (2) the Owner as an additional insured for claims caused in whole or in part by the Contractor's negligent acts or omissions during the Contractor's completed operations.

§ 11.2 OWNER'S LIABILITY INSURANCE

The Owner shall be responsible for purchasing and maintaining the Owner's usual liability insurance.

§ 11.3 PROPERTY INSURANCE

§ 11.3.1 Unless otherwise provided, the Owner shall purchase and maintain, in a company or companies lawfully authorized to do business in the jurisdiction in which the Project is located, property insurance written on a builder's risk "all-risk" or equivalent policy form in the amount of the initial Contract Sum, plus value of subsequent Contract Modifications and cost of materials supplied or installed by others, comprising total value for the entire Project at the site on a replacement cost basis without optional deductibles. Such property insurance shall be maintained, unless otherwise provided in the Contract Documents or otherwise agreed in writing by all persons and entities who are beneficiaries of such insurance, until final payment has been made as provided in Section 9.10 or until no person or entity other than the Owner has an insurable interest in the property required by this Section 11.3 to be covered, whichever is later. This insurance shall include interests of the Owner, the Contractor, Subcontractors and Sub-subcontractors in the Project.

§ 11.3.1.1 Property insurance shall be on an "all-risk" or equivalent policy form and shall include, without limitation, insurance against the perils of fire (with extended coverage) and physical loss or damage including, without duplication of coverage, theft, vandalism, malicious mischief, collapse, earthquake, flood, windstorm, falsework, testing and startup, temporary buildings and debris removal including demolition occasioned by enforcement of any applicable legal requirements, and shall cover reasonable compensation for Architect's and Contractor's services and expenses required as a result of such insured loss.

§ 11.3.1.2 If the Owner does not intend to purchase such property insurance required by the Contract and with all of the coverages in the amount described above, the Owner shall so inform the Contractor in writing prior to commencement of the Work. The Contractor may then effect insurance that will protect the interests of the Contractor, Subcontractors and Sub-subcontractors in the Work, and by appropriate Change Order the cost thereof shall be charged to the Owner. If the Contractor is damaged by the failure or neglect of the Owner to purchase or maintain insurance as described above, without so notifying the Contractor in writing, then the Owner shall bear all reasonable costs properly attributable thereto.

§ 11.3.1.3 If the property insurance requires deductibles, the Owner shall pay costs not covered because of such deductibles.

§ 11.3.1.4 This property insurance shall cover portions of the Work stored off the site, and also portions of the Work in transit.

§ 11.3.1.5 Partial occupancy or use in accordance with Section 9.9 shall not commence until the insurance company or companies providing property insurance have consented to such partial occupancy or use by endorsement or

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otherwise. The Owner and the Contractor shall take reasonable steps to obtain consent of the insurance company or companies and shall, without mutual written consent, take no action with respect to partial occupancy or use that would cause cancellation, lapse or reduction of insurance.

§ 11.3.2 BOILER AND MACHINERY INSURANCE
The Owner shall purchase and maintain boiler and machinery insurance required by the Contract Documents or by law, which shall specifically cover such insured objects during installation and until final acceptance by the Owner; this insurance shall include interests of the Owner, Contractor, Subcontractors and Sub-subcontractors in the Work, and the Owner and Contractor shall be named insureds.

§ 11.3.3 LOSS OF USE INSURANCE
The Owner, at the Owner's option, may purchase and maintain such insurance as will insure the Owner against loss of use of the Owner's property due to fire or other hazards, however caused. The Owner waives all rights of action against the Contractor for loss of use of the Owner's property, including consequential losses due to fire or other hazards however caused.

§ 11.3.4 If the Contractor requests in writing that insurance for risks other than those described herein or other special causes of loss be included in the property insurance policy, the Owner shall, if possible, include such insurance, and the cost thereof shall be charged to the Contractor by appropriate Change Order.

§ 11.3.5 If during the Project construction period the Owner insures properties, real or personal or both, at or adjacent to the site by property insurance under policies separate from those insuring the Project, or if after final payment property insurance is to be provided on the completed Project through a policy or policies other than those insuring the Project during the construction period, the Owner shall waive all rights in accordance with the terms of Section 11.3.7 for damages caused by fire or other causes of loss covered by this separate property insurance. All separate policies shall provide this waiver of subrogation by endorsement or otherwise.

§ 11.3.6 Before an exposure to loss may occur, the Owner shall file with the Contractor a copy of each policy that includes insurance coverages required by this Section 11.3. Each policy shall contain all generally applicable conditions, definitions, exclusions and endorsements related to this Project. Each policy shall contain a provision that the policy will not be canceled or allowed to expire, and that its limits will not be reduced, until at least 30 days' prior written notice has been given to the Contractor.

§ 11.3.7 WAIVERS OF SUBROGATION
The Owner and Contractor waive all rights against (1) each other and any of their subcontractors, sub-subcontractors, agents and employees, each of the other, and (2) the Architect, Architect's consultants, separate contractors described in Article 6, if any, and any of their subcontractors, sub-subcontractors, agents and employees, for damages caused by fire or other causes of loss to the extent covered by property insurance obtained pursuant to this Section 11.3 or other property insurance applicable to the Work, except such rights as they have to proceeds of such insurance held by the Owner as fiduciary. The Owner or Contractor, as appropriate, shall require of the Architect, Architect's consultants, separate contractors described in Article 6, if any, and the subcontractors, sub-subcontractors, agents and employees of any of them, by appropriate agreements, written where legally required for validity, similar waivers each in favor of other parties enumerated herein. The policies shall provide such waivers of subrogation by endorsement or otherwise. A waiver of subrogation shall be effective as to a person or entity even though that person or entity would otherwise have a duty of indemnification, contractual or otherwise, did not pay the insurance premium directly or indirectly, and whether or not the person or entity had an insurable interest in the property damaged.

§ 11.3.8 A loss insured under the Owner's property insurance shall be adjusted by the Owner as fiduciary and made payable to the Owner as fiduciary for the insureds, as their interests may appear, subject to requirements of any applicable mortgagee clause and of Section 11.3.10. The Contractor shall pay Subcontractors their just shares of insurance proceeds received by the Contractor, and by appropriate agreements, written where legally required for validity, shall require Subcontractors to make payments to their Sub-subcontractors in similar manner.

§ 11.3.9 If required in writing by a party in interest, the Owner as fiduciary shall, upon occurrence of an insured loss, give bond for proper performance of the Owner's duties. The cost of required bonds shall be charged against proceeds received as fiduciary. The Owner shall deposit in a separate account proceeds so received, which the

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Owner shall distribute in accordance with such agreement as the parties in interest may reach, or as determined in accordance with the method of binding dispute resolution selected in the Agreement between the Owner and Contractor. If after such loss no other special agreement is made and unless the Owner terminates the Contract for convenience, replacement of damaged property shall be performed by the Contractor after notification of a Change in the Work in accordance with Article 7.

§ 11.3.10 The Owner as fiduciary shall have power to adjust and settle a loss with insurers unless one of the parties in interest shall object in writing within five days after occurrence of loss to the Owner's exercise of this power; if such objection is made, the dispute shall be resolved in the manner selected by the Owner and Contractor as the method of binding dispute resolution in the Agreement. If the Owner and Contractor have selected arbitration as the method of binding dispute resolution, the Owner as fiduciary shall make settlement with insurers or, in the case of a dispute over distribution of insurance proceeds, in accordance with the directions of the arbitrators.

§ 11.4 PERFORMANCE BOND AND PAYMENT BOND

§ 11.4.1 The Owner shall have the right to require the Contractor to furnish bonds covering faithful performance of the Contract and payment of obligations arising thereunder as stipulated in bidding requirements or specifically required in the Contract Documents on the date of execution of the Contract.

§ 11.4.2 Upon the request of any person or entity appearing to be a potential beneficiary of bonds covering payment of obligations arising under the Contract, the Contractor shall promptly furnish a copy of the bonds or shall authorize a copy to be furnished.

ARTICLE 12 UNCOVERING AND CORRECTION OF WORK

§ 12.1 UNCOVERING OF WORK

§ 12.1.1 If a portion of the Work is covered contrary to the Architect's request or to requirements specifically expressed in the Contract Documents, it must, if requested in writing by the Architect, be uncovered for the Architect's examination and be replaced at the Contractor's expense without change in the Contract Time.

§ 12.1.2 If a portion of the Work has been covered that the Architect has not specifically requested to examine prior to its being covered, the Architect may request to see such Work and it shall be uncovered by the Contractor. If such Work is in accordance with the Contract Documents, costs of uncovering and replacement shall, by appropriate Change Order, be at the Owner's expense. If such Work is not in accordance with the Contract Documents, such costs and the cost of correction shall be at the Contractor's expense unless the condition was caused by the Owner or a separate contractor in which event the Owner shall be responsible for payment of such costs.

§ 12.2 CORRECTION OF WORK

§ 12.2.1 BEFORE OR AFTER SUBSTANTIAL COMPLETION

The Contractor shall promptly correct Work rejected by the Architect or failing to conform to the requirements of the Contract Documents, whether discovered before or after Substantial Completion and whether or not fabricated, installed or completed. Costs of correcting such rejected Work, including additional testing and inspections, the cost of uncovering and replacement, and compensation for the Architect's services and expenses made necessary thereby, shall be at the Contractor's expense.

§ 12.2.2 AFTER SUBSTANTIAL COMPLETION

§ 12.2.2.1 In addition to the Contractor's obligations under Section 3.5, if, within one year after the date of Substantial Completion of the Work or designated portion thereof or after the date for commencement of warranties established under Section 9.9.1, or by terms of an applicable special warranty required by the Contract Documents, any of the Work is found to be not in accordance with the requirements of the Contract Documents, the Contractor shall correct it promptly after receipt of written notice from the Owner to do so unless the Owner has previously given the Contractor a written acceptance of such condition. The Owner shall give such notice promptly after discovery of the condition. During the one-year period for correction of Work, if the Owner fails to notify the Contractor and give the Contractor an opportunity to make the correction, the Owner waives the rights to require correction by the Contractor and to make a claim for breach of warranty. If the Contractor fails to correct nonconforming Work within a reasonable time during that period after receipt of notice from the Owner or Architect, the Owner may correct it in accordance with Section 2.4.

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§ 12.2.2.2 The one-year period for correction of Work shall be extended with respect to portions of Work first performed after Substantial Completion by the period of time between Substantial Completion and the actual completion of that portion of the Work.

§ 12.2.2.3 The one-year period for correction of Work shall not be extended by corrective Work performed by the Contractor pursuant to this Section 12.2.

§ 12.2.3 The Contractor shall remove from the site portions of the Work that are not in accordance with the requirements of the Contract Documents and are neither corrected by the Contractor nor accepted by the Owner.

§ 12.2.4 The Contractor shall bear the cost of correcting destroyed or damaged construction, whether completed or partially completed, of the Owner or separate contractors caused by the Contractor's correction or removal of Work that is not in accordance with the requirements of the Contract Documents.

§ 12.2.5 Nothing contained in this Section 12.2 shall be construed to establish a period of limitation with respect to other obligations the Contractor has under the Contract Documents. Establishment of the one-year period for correction of Work as described in Section 12.2.2 relates only to the specific obligation of the Contractor to correct the Work, and has no relationship to the time within which the obligation to comply with the Contract Documents may be sought to be enforced, nor to the time within which proceedings may be commenced to establish the Contractor's liability with respect to the Contractor's obligations other than specifically to correct the Work.

§ 12.3 ACCEPTANCE OF NONCONFORMING WORK

If the Owner prefers to accept Work that is not in accordance with the requirements of the Contract Documents, the Owner may do so instead of requiring its removal and correction, in which case the Contract Sum will be reduced as appropriate and equitable. Such adjustment shall be effected whether or not final payment has been made.

ARTICLE 13 MISCELLANEOUS PROVISIONS

§ 13.1 GOVERNING LAW

The Contract shall be governed by the law of the place where the Project is located except that, if the parties have selected arbitration as the method of binding dispute resolution, the Federal Arbitration Act shall govern Section 15.4.

§ 13.2 SUCCESSORS AND ASSIGNS

§ 13.2.1 The Owner and Contractor respectively bind themselves, their partners, successors, assigns and legal representatives to covenants, agreements and obligations contained in the Contract Documents. Except as provided in Section 13.2.2, neither party to the Contract shall assign the Contract as a whole without written consent of the other. If either party attempts to make such an assignment without such consent, that party shall nevertheless remain legally responsible for all obligations under the Contract.

§ 13.2.2 The Owner may, without consent of the Contractor, assign the Contract to a lender providing construction financing for the Project, if the lender assumes the Owner's rights and obligations under the Contract Documents. The Contractor shall execute all consents reasonably required to facilitate such assignment.

§ 13.3 WRITTEN NOTICE

Written notice shall be deemed to have been duly served if delivered in person to the individual, to a member of the firm or entity, or to an officer of the corporation for which it was intended; or if delivered at, or sent by registered or certified mail or by courier service providing proof of delivery to, the last business address known to the party giving notice.

§ 13.4 RIGHTS AND REMEDIES

§ 13.4.1 Duties and obligations imposed by the Contract Documents and rights and remedies available thereunder shall be in addition to and not a limitation of duties, obligations, rights and remedies otherwise imposed or available by law.

§ 13.4.2 No action or failure to act by the Owner, Architect or Contractor shall constitute a waiver of a right or duty afforded them under the Contract, nor shall such action or failure to act constitute approval of or acquiescence in a breach there under, except as may be specifically agreed in writing.

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§ 13.5 TESTS AND INSPECTIONS

§ 13.5.1 Tests, inspections and approvals of portions of the Work shall be made as required by the Contract Documents and by applicable laws, statutes, ordinances, codes, rules and regulations or lawful orders of public authorities. Unless otherwise provided, the Contractor shall make arrangements for such tests, inspections and approvals with an independent testing laboratory or entity acceptable to the Owner, or with the appropriate public authority, and shall bear all related costs of tests, inspections and approvals. The Contractor shall give the Architect timely notice of when and where tests and inspections are to be made so that the Architect may be present for such procedures. The Owner shall bear costs of (1) tests, inspections or approvals that do not become requirements until after bids are received or negotiations concluded, and (2) tests, inspections or approvals where building codes or applicable laws or regulations prohibit the Owner from delegating their cost to the Contractor.

§ 13.5.2 If the Architect, Owner or public authorities having jurisdiction determine that portions of the Work require additional testing, inspection or approval not included under Section 13.5.1, the Architect will, upon written authorization from the Owner, instruct the Contractor to make arrangements for such additional testing, inspection or approval by an entity acceptable to the Owner, and the Contractor shall give timely notice to the Architect of when and where tests and inspections are to be made so that the Architect may be present for such procedures. Such costs, except as provided in Section 13.5.3, shall be at the Owner's expense.

§ 13.5.3 If such procedures for testing, inspection or approval under Sections 13.5.1 and 13.5.2 reveal failure of the portions of the Work to comply with requirements established by the Contract Documents, all costs made necessary by such failure including those of repeated procedures and compensation for the Architect's services and expenses shall be at the Contractor's expense.

§ 13.5.4 Required certificates of testing, inspection or approval shall, unless otherwise required by the Contract Documents, be secured by the Contractor and promptly delivered to the Architect.

§ 13.5.5 If the Architect is to observe tests, inspections or approvals required by the Contract Documents, the Architect will do so promptly and, where practicable, at the normal place of testing.

§ 13.5.6 Tests or inspections conducted pursuant to the Contract Documents shall be made promptly to avoid unreasonable delay in the Work.

§ 13.6 INTEREST

Payments due and unpaid under the Contract Documents shall bear interest from the date payment is due at such rate as the parties may agree upon in writing or, in the absence thereof, at the legal rate prevailing from time to time at the place where the Project is located.

§ 13.7 TIME LIMITS ON CLAIMS

The Owner and Contractor shall commence all claims and causes of action, whether in contract, tort, breach of warranty or otherwise, against the other arising out of or related to the Contract in accordance with the requirements of the final dispute resolution method selected in the Agreement within the time period specified by applicable law, but in any case not more than 10 years after the date of Substantial Completion of the Work. The Owner and Contractor waive all claims and causes of action not commenced in accordance with this Section 13.7.

ARTICLE 14 TERMINATION OR SUSPENSION OF THE CONTRACT

§ 14.1 TERMINATION BY THE CONTRACTOR

§ 14.1.1 The Contractor may terminate the Contract if the Work is stopped for a period of 30 consecutive days through no act or fault of the Contractor or a Subcontractor, Sub-subcontractor or their agents or employees or any other persons or entities performing portions of the Work under direct or indirect contract with the Contractor, for any of the following reasons:

- **.1** Issuance of an order of a court or other public authority having jurisdiction that requires all Work to be stopped;
- **.2** An act of government, such as a declaration of national emergency that requires all Work to be stopped;

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.3 Because the Architect has not issued a Certificate for Payment and has not notified the Contractor of the reason for withholding certification as provided in Section 9.4.1, or because the Owner has not made payment on a Certificate for Payment within the time stated in the Contract Documents; or

.4 The Owner has failed to furnish to the Contractor promptly, upon the Contractor's request, reasonable evidence as required by Section 2.2.1.

§ 14.1.2 The Contractor may terminate the Contract if, through no act or fault of the Contractor or a Subcontractor, Sub-subcontractor or their agents or employees or any other persons or entities performing portions of the Work under direct or indirect contract with the Contractor, repeated suspensions, delays or interruptions of the entire Work by the Owner as described in Section 14.3 constitute in the aggregate more than 100 percent of the total number of days scheduled for completion, or 120 days in any 365-day period, whichever is less.

§ 14.1.3 If one of the reasons described in Section 14.1.1 or 14.1.2 exists, the Contractor may, upon seven days' written notice to the Owner and Architect, terminate the Contract and recover from the Owner payment for Work executed, including reasonable overhead and profit, costs incurred by reason of such termination, and damages.

§ 14.1.4 If the Work is stopped for a period of 60 consecutive days through no act or fault of the Contractor or a Subcontractor or their agents or employees or any other persons performing portions of the Work under contract with the Contractor because the Owner has repeatedly failed to fulfill the Owner's obligations under the Contract Documents with respect to matters important to the progress of the Work, the Contractor may, upon seven additional days' written notice to the Owner and the Architect, terminate the Contract and recover from the Owner as provided in Section 14.1.3.

§ 14.2 TERMINATION BY THE OWNER FOR CAUSE

§ 14.2.1 The Owner may terminate the Contract if the Contractor

.1 repeatedly refuses or fails to supply enough properly skilled workers or proper materials;

.2 fails to make payment to Subcontractors for materials or labor in accordance with the respective agreements between the Contractor and the Subcontractors;

.3 repeatedly disregards applicable laws, statutes, ordinances, codes, rules and regulations, or lawful orders of a public authority; or

.4 otherwise is guilty of substantial breach of a provision of the Contract Documents.

§ 14.2.2 When any of the above reasons exist, the Owner, upon certification by the Initial Decision Maker that sufficient cause exists to justify such action, may without prejudice to any other rights or remedies of the Owner and after giving the Contractor and the Contractor's surety, if any, seven days' written notice, terminate employment of the Contractor and may, subject to any prior rights of the surety:

.1 Exclude the Contractor from the site and take possession of all materials, equipment, tools, and construction equipment and machinery thereon owned by the Contractor;

.2 Accept assignment of subcontracts pursuant to Section 5.4; and

.3 Finish the Work by whatever reasonable method the Owner may deem expedient. Upon written request of the Contractor, the Owner shall furnish to the Contractor a detailed accounting of the costs incurred by the Owner in finishing the Work.

§ 14.2.3 When the Owner terminates the Contract for one of the reasons stated in Section 14.2.1, the Contractor shall not be entitled to receive further payment until the Work is finished.

§ 14.2.4 If the unpaid balance of the Contract Sum exceeds costs of finishing the Work, including compensation for the Architect's services and expenses made necessary thereby, and other damages incurred by the Owner and not expressly waived, such excess shall be paid to the Contractor. If such costs and damages exceed the unpaid balance, the Contractor shall pay the difference to the Owner. The amount to be paid to the Contractor or Owner, as the case may be, shall be certified by the Initial Decision Maker, upon application, and this obligation for payment shall survive termination of the Contract.

§ 14.3 SUSPENSION BY THE OWNER FOR CONVENIENCE

§ 14.3.1 The Owner may, without cause, order the Contractor in writing to suspend, delay or interrupt the Work in whole or in part for such period of time as the Owner may determine.

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§ 14.3.2 The Contract Sum and Contract Time shall be adjusted for increases in the cost and time caused by suspension, delay or interruption as described in Section 14.3.1. Adjustment of the Contract Sum shall include profit. No adjustment shall be made to the extent

.1 that performance is, was or would have been so suspended, delayed or interrupted by another cause for which the Contractor is responsible; or

.2 that an equitable adjustment is made or denied under another provision of the Contract.

§ 14.4 TERMINATION BY THE OWNER FOR CONVENIENCE

§ 14.4.1 The Owner may, at any time, terminate the Contract for the Owner's convenience and without cause.

§ 14.4.2 Upon receipt of written notice from the Owner of such termination for the Owner's convenience, the Contractor shall

.1 cease operations as directed by the Owner in the notice;

.2 take actions necessary, or that the Owner may direct, for the protection and preservation of the Work; and

.3 except for Work directed to be performed prior to the effective date of termination stated in the notice, terminate all existing subcontracts and purchase orders and enter into no further subcontracts and purchase orders.

§ 14.4.3 In case of such termination for the Owner's convenience, the Contractor shall be entitled to receive payment for Work executed, and costs incurred by reason of such termination, along with reasonable overhead and profit on the Work not executed.

ARTICLE 15 CLAIMS AND DISPUTES

§ 15.1 CLAIMS

§ 15.1.1 DEFINITION

A Claim is a demand or assertion by one of the parties seeking, as a matter of right, payment of money, or other relief with respect to the terms of the Contract. The term "Claim" also includes other disputes and matters in question between the Owner and Contractor arising out of or relating to the Contract. The responsibility to substantiate Claims shall rest with the party making the Claim.

§ 15.1.2 NOTICE OF CLAIMS

Claims by either the Owner or Contractor must be initiated by written notice to the other party and to the Initial Decision Maker with a copy sent to the Architect, if the Architect is not serving as the Initial Decision Maker. Claims by either party must be initiated within 21 days after occurrence of the event giving rise to such Claim or within 21 days after the claimant first recognizes the condition giving rise to the Claim, whichever is later.

§ 15.1.3 CONTINUING CONTRACT PERFORMANCE

Pending final resolution of a Claim, except as otherwise agreed in writing or as provided in Section 9.7 and Article 14, the Contractor shall proceed diligently with performance of the Contract and the Owner shall continue to make payments in accordance with the Contract Documents. The Architect will prepare Change Orders and issue Certificates for Payment in accordance with the decisions of the Initial Decision Maker.

§ 15.1.4 CLAIMS FOR ADDITIONAL COST

If the Contractor wishes to make a Claim for an increase in the Contract Sum, written notice as provided herein shall be given before proceeding to execute the Work. Prior notice is not required for Claims relating to an emergency endangering life or property arising under Section 10.4.

§ 15.1.5 CLAIMS FOR ADDITIONAL TIME

§ 15.1.5.1 If the Contractor wishes to make a Claim for an increase in the Contract Time, written notice as provided herein shall be given. The Contractor's Claim shall include an estimate of cost and of probable effect of delay on progress of the Work. In the case of a continuing delay, only one Claim is necessary.

§ 15.1.5.2 If adverse weather conditions are the basis for a Claim for additional time, such Claim shall be documented by data substantiating that weather conditions were abnormal for the period of time, could not have been reasonably anticipated and had an adverse effect on the scheduled construction.

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§ 15.1.6 CLAIMS FOR CONSEQUENTIAL DAMAGES

The Contractor and Owner waive Claims against each other for consequential damages arising out of or relating to this Contract. This mutual waiver includes

.1 damages incurred by the Owner for rental expenses, for losses of use, income, profit, financing, business and reputation, and for loss of management or employee productivity or of the services of such persons; and

.2 damages incurred by the Contractor for principal office expenses including the compensation of personnel stationed there, for losses of financing, business and reputation, and for loss of profit except anticipated profit arising directly from the Work.

This mutual waiver is applicable, without limitation, to all consequential damages due to either party's termination in accordance with Article 14. Nothing contained in this Section 15.1.6 shall be deemed to preclude an award of liquidated damages, when applicable, in accordance with the requirements of the Contract Documents.

§ 15.2 INITIAL DECISION

§ 15.2.1 Claims, excluding those arising under Sections 10.3, 10.4, 11.3.9, and 11.3.10, shall be referred to the Initial Decision Maker for initial decision. The Architect will serve as the Initial Decision Maker, unless otherwise indicated in the Agreement. Except for those Claims excluded by this Section 15.2.1, an initial decision shall be required as a condition precedent to mediation of any Claim arising prior to the date final payment is due, unless 30 days have passed after the Claim has been referred to the Initial Decision Maker with no decision having been rendered. Unless the Initial Decision Maker and all affected parties agree, the Initial Decision Maker will not decide disputes between the Contractor and persons or entities other than the Owner.

§ 15.2.2 The Initial Decision Maker will review Claims and within ten days of the receipt of a Claim take one or more of the following actions: (1) request additional supporting data from the claimant or a response with supporting data from the other party, (2) reject the Claim in whole or in part, (3) approve the Claim, (4) suggest a compromise, or (5) advise the parties that the Initial Decision Maker is unable to resolve the Claim if the Initial Decision Maker lacks sufficient information to evaluate the merits of the Claim or if the Initial Decision Maker concludes that, in the Initial Decision Maker's sole discretion, it would be inappropriate for the Initial Decision Maker to resolve the Claim.

§ 15.2.3 In evaluating Claims, the Initial Decision Maker may, but shall not be obligated to, consult with or seek information from either party or from persons with special knowledge or expertise who may assist the Initial Decision Maker in rendering a decision. The Initial Decision Maker may request the Owner to authorize retention of such persons at the Owner's expense.

§ 15.2.4 If the Initial Decision Maker requests a party to provide a response to a Claim or to furnish additional supporting data, such party shall respond, within ten days after receipt of such request, and shall either (1) provide a response on the requested supporting data, (2) advise the Initial Decision Maker when the response or supporting data will be furnished or (3) advise the Initial Decision Maker that no supporting data will be furnished. Upon receipt of the response or supporting data, if any, the Initial Decision Maker will either reject or approve the Claim in whole or in part.

§ 15.2.5 The Initial Decision Maker will render an initial decision approving or rejecting the Claim, or indicating that the Initial Decision Maker is unable to resolve the Claim. This initial decision shall (1) be in writing; (2) state the reasons therefor; and (3) notify the parties and the Architect, if the Architect is not serving as the Initial Decision Maker, of any change in the Contract Sum or Contract Time or both. The initial decision shall be final and binding on the parties but subject to mediation and, if the parties fail to resolve their dispute through mediation, to binding dispute resolution.

§ 15.2.6 Either party may file for mediation of an initial decision at any time, subject to the terms of Section 15.2.6.1.

§ 15.2.6.1 Either party may, within 30 days from the date of an initial decision, demand in writing that the other party file for mediation within 60 days of the initial decision. If such a demand is made and the party receiving the demand fails to file for mediation within the time required, then both parties waive their rights to mediate or pursue binding dispute resolution proceedings with respect to the initial decision.

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§ 15.2.7 In the event of a Claim against the Contractor, the Owner may, but is not obligated to, notify the surety, if any, of the nature and amount of the Claim. If the Claim relates to a possibility of a Contractor's default, the Owner may, but is not obligated to, notify the surety and request the surety's assistance in resolving the controversy.

§ 15.2.8 If a Claim relates to or is the subject of a mechanic's lien, the party asserting such Claim may proceed in accordance with applicable law to comply with the lien notice or filing deadlines.

§ 15.3 MEDIATION

§ 15.3.1 Claims, disputes, or other matters in controversy arising out of or related to the Contract except those waived as provided for in Sections 9.10.4, 9.10.5, and 15.1.6 shall be subject to mediation as a condition precedent to binding dispute resolution.

§ 15.3.2 The parties shall endeavor to resolve their Claims by mediation which, unless the parties mutually agree otherwise, shall be administered by the American Arbitration Association in accordance with its Construction Industry Mediation Procedures in effect on the date of the Agreement. A request for mediation shall be made in writing, delivered to the other party to the Contract, and filed with the person or entity administering the mediation. The request may be made concurrently with the filing of binding dispute resolution proceedings but, in such event, mediation shall proceed in advance of binding dispute resolution proceedings, which shall be stayed pending mediation for a period of 60 days from the date of filing, unless stayed for a longer period by agreement of the parties or court order. If an arbitration is stayed pursuant to this Section 15.3.2, the parties may nonetheless proceed to the selection of the arbitrator(s) and agree upon a schedule for later proceedings.

§ 15.3.3 The parties shall share the mediator's fee and any filing fees equally. The mediation shall be held in the place where the Project is located, unless another location is mutually agreed upon. Agreements reached in mediation shall be enforceable as settlement agreements in any court having jurisdiction thereof.

§ 15.4 ARBITRATION

§ 15.4.1 If the parties have selected arbitration as the method for binding dispute resolution in the Agreement, any Claim subject to, but not resolved by, mediation shall be subject to arbitration which, unless the parties mutually agree otherwise, shall be administered by the American Arbitration Association in accordance with its Construction Industry Arbitration Rules in effect on the date of the Agreement. A demand for arbitration shall be made in writing, delivered to the other party to the Contract, and filed with the person or entity administering the arbitration. The party filing a notice of demand for arbitration must assert in the demand all Claims then known to that party on which arbitration is permitted to be demanded.

§ 15.4.1.1 A demand for arbitration shall be made no earlier than concurrently with the filing of a request for mediation, but in no event shall it be made after the date when the institution of legal or equitable proceedings based on the Claim would be barred by the applicable statute of limitations. For statute of limitations purposes, receipt of a written demand for arbitration by the person or entity administering the arbitration shall constitute the institution of legal or equitable proceedings based on the Claim.

§ 15.4.2 The award rendered by the arbitrator or arbitrators shall be final, and judgment may be entered upon it in accordance with applicable law in any court having jurisdiction thereof.

§ 15.4.3 The foregoing agreement to arbitrate and other agreements to arbitrate with an additional person or entity duly consented to by parties to the Agreement shall be specifically enforceable under applicable law in any court having jurisdiction thereof.

§ 15.4.4 CONSOLIDATION OR JOINDER

§ 15.4.4.1 Either party, at its sole discretion, may consolidate an arbitration conducted under this Agreement with any other arbitration to which it is a party provided that (1) the arbitration agreement governing the other arbitration permits consolidation, (2) the arbitrations to be consolidated substantially involve common questions of law or fact, and (3) the arbitrations employ materially similar procedural rules and methods for selecting arbitrator(s).

§ 15.4.4.2 Either party, at its sole discretion, may include by joinder persons or entities substantially involved in a common question of law or fact whose presence is required if complete relief is to be accorded in arbitration, provided that the party sought to be joined consents in writing to such joinder. Consent to arbitration involving an

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additional person or entity shall not constitute consent to arbitration of any claim, dispute or other matter in question not described in the written consent.

§ 15.4.4.3 The Owner and Contractor grant to any person or entity made a party to an arbitration conducted under this Section 15.4, whether by joinder or consolidation, the same rights of joinder and consolidation as the Owner and Contractor under this Agreement.

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Additions and Deletions Report for

AIA® Document A201™ – 2007

This Additions and Deletions Report, as defined on page 1 of the associated document, reproduces below all text the author has added to the standard form AIA document in order to complete it, as well as any text the author may have added to or deleted from the original AIA text. Added text is shown underlined. Deleted text is indicated with a horizontal line through the original AIA text.

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PAGE 1

Draft

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Certification of Document's Authenticity

AIA® Document D401™ – 2003

I, Joseph H. Coates; Architect , hereby certify, to the best of my knowledge, information and belief, that I created the attached final document simultaneously with its associated Additions and Deletions Report and this certification at 10:53:30 on 06/03/2011 under Order No. 1023474761_1 from AIA Contract Documents software and that in preparing the attached final document I made no changes to the original text of AIA® Document A201™ – 2007, General Conditions of the Contract for Construction, as published by the AIA in its software, other than those additions and deletions shown in the associated Additions and Deletions Report.

_____

(Signed)

_____

(Title)

_____

(Dated)

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EXAMPLE

AIA® Document G701™ – 2001

Change Order

PROJECT *(Name and address)*:	**CHANGE ORDER NUMBER:** **DATE:**	OWNER: ☐ ARCHITECT: ☐
TO CONTRACTOR *(Name and address)*:	**ARCHITECT'S PROJECT NUMBER:** **CONTRACT DATE:** **CONTRACT FOR:** General Construction	CONTRACTOR: ☐ FIELD: ☐ OTHER: ☐

THE CONTRACT IS CHANGED AS FOLLOWS:
(Include, where applicable, any undisputed amount attributable to previously executed Construction Change Directives)

The original Contract Sum was	$	0.00
The net change by previously authorized Change Orders	$	0.00
The Contract Sum prior to this Change Order was	$	0.00
The Contract Sum will be increased by this Change Order in the amount of	$	0.00
The new Contract Sum including this Change Order will be	$	0.00

The Contract Time will be increased by Zero (0) days.
The date of Substantial Completion as of the date of this Change Order therefore is

NOTE: This Change Order does not include changes in the Contract Sum, Contract Time or Guaranteed Maximum Price which have been authorized by Construction Change Directive until the cost and time have been agreed upon by both the Owner and Contractor, in which case a Change Order is executed to supersede the Construction Change Directive.

NOT VALID UNTIL SIGNED BY THE ARCHITECT, CONTRACTOR AND OWNER.

ARCHITECT *(Firm name)*	**CONTRACTOR** *(Firm name)*	**OWNER** *(Firm name)*
ADDRESS	**ADDRESS**	**ADDRESS**
BY *(Signature)*	**BY** *(Signature)*	**BY** *(Signature)*
(Typed name)	*(Typed name)*	*(Typed name)*
DATE	**DATE**	**DATE**

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AIA® Document G702™ – 1992

EXAMPLE

Application and Certificate for Payment

TO OWNER:

PROJECT:

APPLICATION NO: 001
PERIOD TO:
CONTRACT FOR: General Construction
CONTRACT DATE:
PROJECT NOS: / /

Distribution to:
OWNER:
ARCHITECT:
CONTRACTOR:
FIELD:
OTHER:

FROM CONTRACTOR:

VIA ARCHITECT:

CONTRACTOR'S APPLICATION FOR PAYMENT

Application is made for payment, as shown below, in connection with the Contract.
Continuation Sheet, AIA Document G703, is attached.

1. ORIGINAL CONTRACT SUM ..... $ 0.00

2. NET CHANGE BY CHANGE ORDERS ..... $ 0.00

3. CONTRACT SUM TO DATE (Line 1 ± 2) ..... $ 0.00

4. TOTAL COMPLETED & STORED TO DATE (Column G on G703) ..... $ 0.00

5. RETAINAGE:

a. 0 % of Completed Work
(Column D + E on G703) $ 0.00

b. 0 % of Stored Material
(Column F on G703) $ 0.00

Total Retainage (Lines 5a + 5b or Total in Column I of G703) ..... $ 0.00

6. TOTAL EARNED LESS RETAINAGE ..... $ 0.00
(Line 4 Less Line 5 Total)

7. LESS PREVIOUS CERTIFICATES FOR PAYMENT ..... $ 0.00
(Line 6 from prior Certificate)

8. CURRENT PAYMENT DUE ..... $ 0.00

9. BALANCE TO FINISH, INCLUDING RETAINAGE
(Line 3 less Line 6) $ 0.00

CHANGE ORDER SUMMARY	ADDITIONS	DEDUCTIONS
Total changes approved in previous months by Owner	$ 0.00	$ 0.00
Total approved this Month	$ 0.00	$ 0.00
TOTALS	$ 0.00	$ 0.00
NET CHANGES by Change Order	$ 0.00	

The undersigned Contractor certifies that to the best of the Contractor's knowledge, information and belief the Work covered by this Application for Payment has been completed in accordance with the Contract Documents, that all amounts have been paid by the Contractor for Work for which previous Certificates for Payment were issued and payments received from the Owner, and that current payment shown herein is now due.

CONTRACTOR:

By: _____ Date: _____

State of:

County of:

Subscribed and sworn to before me this day of

Notary Public:

My Commission expires:

ARCHITECT'S CERTIFICATE FOR PAYMENT

In accordance with the Contract Documents, based on on-site observations and the data comprising this application, the Architect certifies to the Owner that to the best of the Architect's knowledge, information and belief the Work has progressed as indicated, the quality of the Work is in accordance with the Contract Documents, and the Contractor is entitled to payment of the AMOUNT CERTIFIED.

AMOUNT CERTIFIED ..... $ 0.00

(Attach explanation if amount certified differs from the amount applied. Initial all figures on this Application and on the Continuation Sheet that are changed to conform with the amount certified.)

ARCHITECT:

By: _____ Date: _____

This Certificate is not negotiable. The AMOUNT CERTIFIED is payable only to the Contractor named herein. Issuance, payment and acceptance of payment are without prejudice to any rights of the Owner or Contractor under this Contract.

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AIA® Document G703™ – 1992

EXAMPLE

Continuation Sheet

AIA Document, G702™–1992, Application and Certification for Payment, or G736™–2009, Project Application and Project Certificate for Payment, Construction Manager as Adviser Edition, containing Contractor's signed certification is attached.
In tabulations below, amounts are in US dollars.
Use Column I on Contracts where variable retainage for line items may apply.

APPLICATION NO: 001
APPLICATION DATE:
PERIOD TO:
ARCHITECT'S PROJECT NO:

A	B	C	D	E	F	G		H	I
			WORK COMPLETED						
ITEM NO.	DESCRIPTION OF WORK	SCHEDULED VALUE	FROM PREVIOUS APPLICATION (D + E)	THIS PERIOD	MATERIALS PRESENTLY STORED (NOT IN D OR E)	TOTAL COMPLETED AND STORED TO DATE (D+E+F)	% (G ÷ C)	BALANCE TO FINISH (C - G)	RETAINAGE (IF VARIABLE RATE)
		0.00	0.00	0.00	0.00	0.00	0.00 %	0.00	0.00
		0.00	0.00	0.00	0.00	0.00	0.00 %	0.00	0.00
		0.00	0.00	0.00	0.00	0.00	0.00 %	0.00	0.00
		0.00	0.00	0.00	0.00	0.00	0.00 %	0.00	0.00
		0.00	0.00	0.00	0.00	0.00	0.00 %	0.00	0.00
		0.00	0.00	0.00	0.00	0.00	0.00 %	0.00	0.00
		0.00	0.00	0.00	0.00	0.00	0.00 %	0.00	0.00
		0.00	0.00	0.00	0.00	0.00	0.00 %	0.00	0.00
		0.00	0.00	0.00	0.00	0.00	0.00 %	0.00	0.00
		0.00	0.00	0.00	0.00	0.00	0.00 %	0.00	0.00
		0.00	0.00	0.00	0.00	0.00	0.00 %	0.00	0.00
		0.00	0.00	0.00	0.00	0.00	0.00 %	0.00	0.00
		0.00	0.00	0.00	0.00	0.00	0.00 %	0.00	0.00
		0.00	0.00	0.00	0.00	0.00	0.00 %	0.00	0.00
		0.00	0.00	0.00	0.00	0.00	0.00 %	0.00	0.00
		0.00	0.00	0.00	0.00	0.00	0.00 %	0.00	0.00
		0.00	0.00	0.00	0.00	0.00	0.00 %	0.00	0.00
		0.00	0.00	0.00	0.00	0.00	0.00 %	0.00	0.00
		0.00	0.00	0.00	0.00	0.00	0.00 %	0.00	0.00
	GRAND TOTAL	$0.00	$0.00	$0.00	$0.00	$0.00	0.00 %	$0.00	$0.00

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EXAMPLE

AIA® Document G704™ – 2000

Certificate of Substantial Completion

PROJECT:
(Name and address)
.

PROJECT NUMBER: /
CONTRACT FOR: General Construction
CONTRACT DATE:

OWNER: ☐
ARCHITECT: ☐
CONTRACTOR: ☐
FIELD: ☐
OTHER: ☐

TO OWNER:
(Name and address)

TO CONTRACTOR:
(Name and address)

PROJECT OR PORTION OF THE PROJECT DESIGNATED FOR PARTIAL OCCUPANCY OR USE SHALL INCLUDE:

The Work performed under this Contract has been reviewed and found, to the Architect's best knowledge, information and belief, to be substantially complete. Substantial Completion is the stage in the progress of the Work when the Work or designated portion is sufficiently complete in accordance with the Contract Documents so that the Owner can occupy or utilize the Work for its intended use. The date of Substantial Completion of the Project or portion designated above is the date of issuance established by this Certificate, which is also the date of commencement of applicable warranties required by the Contract Documents, except as stated below:

Warranty **Date of Commencement**

ARCHITECT **BY** **DATE OF ISSUANCE**

A list of items to be completed or corrected is attached hereto. The failure to include any items on such list does not alter the responsibility of the Contractor to complete all Work in accordance with the Contract Documents. Unless otherwise agreed to in writing, the date of commencement of warranties for items on the attached list will be the date of issuance of the final Certificate of Payment or the date of final payment.

Cost estimate of Work that is incomplete or defective: $200,000.00

The Contractor will complete or correct the Work on the list of items attached hereto within Thirty (30) days from the above date of Substantial Completion.

CONTRACTOR **BY** **DATE**

The Owner accepts the Work or designated portion as substantially complete and will assume full possession at (time) on (date).

.

OWNER **BY** **DATE**

The responsibilities of the Owner and Contractor for security, maintenance, heat, utilities, damage to the Work and insurance shall be as follows:
(Note: Owner's and Contractor's legal and insurance counsel should determine and review insurance requirements and coverage.)

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EXAMPLE

AIA® Document G709™ – 2001

Work Changes Proposal Request

PROJECT *(Name and address)*:

OWNER *(Name and address)*:

FROM ARCHITECT *(Name and address)*:

TO CONTRACTOR *(Name and address)*:

PROPOSAL REQUEST NUMBER:

DATE OF ISSUANCE:

CONTRACT FOR: General Construction

CONTRACT DATE:

ARCHITECT'S PROJECT NUMBER:

OWNER: ☐
ARCHITECT: ☐
CONSULTANT: ☐
CONTRACTOR: ☐
FIELD: ☐
OTHER: ☐

Please submit an itemized proposal for changes in the Contract Sum and Contract Time for proposed modifications to the Contract Documents described herein. Within seven (7) days, the Contractor must submit this proposal or notify the Architect, in writing, of the date on which proposal submission is anticipated.

THIS IS NOT A CHANGE ORDER, A CONSTRUCTION CHANGE DIRECTIVE OR A DIRECTION TO PROCEED WITH THE WORK DESCRIBED IN THE PROPOSED MODIFICATIONS.

DESCRIPTION *(Insert a written description of the Work)*:

ATTACHMENTS *(List attached documents that support description)*:

REQUESTED BY THE ARCHITECT:

_____ _____

(Signature) *(Printed name and title)*

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EXAMPLE

AIA® Document G710™ – 1992

Architect's Supplemental Instructions

PROJECT *(Name and address)*:

OWNER *(Name and address)*:

FROM ARCHITECT *(Name and address)*:

TO CONTRACTOR *(Name and address)*:

ARCHITECT'S SUPPLEMENTAL INSTRUCTION NO:

DATE OF ISSUANCE:

CONTRACT FOR: General Construction

CONTRACT DATE:

ARCHITECT'S PROJECT NUMBER:

OWNER: ☒
ARCHITECT: ☒
CONSULTANT: ☐
CONTRACTOR: ☒
FIELD: ☐
OTHER: ☐

The Work shall be carried out in accordance with the following supplemental instructions issued in accordance with the Contract Documents without change in Contract Sum or Contract Time. Proceeding with the Work in accordance with these instructions indicates your acknowledgment that there will be no change in the Contract Sum or Contract Time.

DESCRIPTION:

ATTACHMENTS:
(Here insert listing of documents that support description.)

ISSUED BY THE ARCHITECT:

(Signature) _____ *(Printed name and title)* _____

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EXAMPLE

AIA® Document G714™ – 2007

Construction Change Directive

PROJECT: *(Name and address)*

TO CONTRACTOR: *(Name and address)*

DIRECTIVE NUMBER:
DATE:
CONTRACT FOR:

CONTRACT DATED:
ARCHITECT'S PROJECT NUMBER:

OWNER: ☐
ARCHITECT: ☐
CONSULTANT: ☐
CONTRACTOR: ☐
FIELD: ☐
OTHER: ☐

You are hereby directed to make the following change(s) in this Contract:
(Describe briefly any proposed changes or list any attached information in the alternative)

Make changes to the underground plumbing, waste and vent as shown on the attached sheet P101 delta 17.

PROPOSED ADJUSTMENTS

1. The proposed basis of adjustment to the Contract Sum or Guaranteed Maximum Price is:

- ☐ Lump Sum decrease of $0.00
- ☐ Unit Price of $ per
- ☐ As provided in Section 7.3.3 of AIA Document A201-2007
- ☐ As follows:

2. The Contract Time is proposed to (remain unchanged). The proposed adjustment, if any, is 0 days.

When signed by the Owner and Architect and received by the Contractor, this document becomes effective IMMEDIATELY as a Construction Change Directive (CCD), and the Contractor shall proceed with the change(s) described above.

Contractor signature indicates agreement with the proposed adjustments in Contract Sum and Contract Time set forth in this CCD.

ARCHITECT *(Firm name)*	**OWNER** *(Firm name)*	**CONTRACTOR** *(Firm name)*
ADDRESS	**ADDRESS**	**ADDRESS**
BY *(Signature)*	**BY** *(Signature)*	**BY** *(Signature)*
(Typed name)	*(Typed name)*	*(Typed name)*
DATE	**DATE**	**DATE**

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DOCUMENT 00 31 19 - EXISTING CONDITION INFORMATION

PART 1 - GENERAL

1.1 EXISTING CONDITION INFORMATION

A. This Document with its referenced attachments is part of the Procurement and Contracting Requirements for Project. They provide Owner's information for Bidders' convenience and are intended to supplement rather than serve in lieu of the Bidders' own investigations. They are made available for Bidders' convenience and information. This Document and its attachments are not part of the Contract Documents.

B. Existing Drawings that include information on existing conditions, including previous construction at Project site are available for viewing in PDF format .

C. Survey information that includes information on existing conditions, prepared by Ensign Engineering, dated September 4, 2026, is available for viewing as part of Drawings.

D. Related Requirements:

1. Document 003132 "Geotechnical Data" for reports and soil-boring data from geotechnical investigations that are made available to Bidders.

PART 2 - PRODUCTS (Not Used)
PART 3 - EXECUTION (Not Used)

END OF DOCUMENT 00 31 19

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DOCUMENT 00 31 32 - GEOTECHNICAL DATA

PART 1 - GENERAL

1.1 GEOTECHNICAL DATA

A. This Document, with its referenced attachments, is part of the Procurement and Contracting Requirements for the Project. They provide Owner's information for Bidders' convenience and are intended to supplement rather than serve in lieu of Bidders' own investigations. They are made available for Bidders' convenience and information. This Document and its attachments are not part of the Contract Documents.

B. Because subsurface conditions indicated by the soil borings are a sampling in relation to the entire construction area, and for other reasons, Owner, Architect, Architect's consultants, and the firm reporting the subsurface conditions do not warranty the conditions below the depths of the borings or that the strata logged from the borings are necessarily typical of the entire site. Any party using the information described in the soil borings and geotechnical report accepts full responsibility for its use.

C. A Geotechnical Investigation Report for Project, prepared by AGEC, dated July 14, 2026, is available for viewing as appended to this Project Manual.

1. The opinions expressed in this report are those of a geotechnical engineer and represent interpretations of subsoil conditions, tests, and results of analyses conducted by a geotechnical engineer. Owner is not responsible for interpretations or conclusions drawn from the data.
2. Any party using information described in the geotechnical report will make additional test borings and conduct other exploratory operations that may be required to determine the character of subsurface materials that may be encountered.

D. Related Requirements:

1. Document 003119 "Existing Condition Information" for information about existing conditions that is made available to Bidders.

PART 2 - PRODUCTS (Not Used)
PART 3 - EXECUTION (Not Used)

END OF DOCUMENT 00 31 32

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AGEC
Applied GeoTech

GEOTECHNICAL INVESTIGATION

LOUISA MAY ALCOTT COMMUNITY SCHOOL

1150 EAST 1200 NORTH

MAPLETON, UTAH

PREPARED FOR:

LOUISA MAY ALCOTT COMMUNITY SCHOOL
C/O BABCOCK DESIGN GROUP
52 EXCHANGE PLACE
SALT LAKE CITY, UT 84111

ATTENTION: RICKY PARKINSON

PROJECT NO. 1260315 **JULY 14, 2026**

600 West Sandy Parkway • Sandy, Utah 84070 • (801) 566-6399 • www.agecinc.com

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APPENDIX
- MULTI-CHANNEL ANALYSIS OF SURFACE WAVES (MASW)
- MICROTREMOR ARRAY MEASUREMENTS (MAM)

EXECUTIVE SUMMARY

1. Approximately 1 foot of topsoil was encountered in the borings except for Boring B-6 where approximately 1 foot of fill was encountered. Clay was encountered below the topsoil to depths of approximately 1½, 2½, 3, 4½, 2½ and 3 feet in Borings B-2, B-3, B-4, B-5, B-7 and B-8, respectively. Gravel was encountered below the clay in these borings and below the topsoil and fill in Borings B-1 and B-6. The gravel extends to the full depth investigated, approximately 18 feet. Practical auger refusal was met at depths of approximately 18, 10, 6, 12 and 10 feet in Borings B-1 through B-5, respectively.

2. No subsurface water was encountered to the depth investigated, approximately 18 feet.

3. With the proposed construction and the subsurface conditions encountered, the proposed building may be supported on spread footings bearing on the undisturbed natural gravel or on compacted structural fill extending down to the undisturbed natural gravel. Spread footings may be designed using an allowable net bearing pressure of 3,500 pounds per square foot.

4. The upper soil in some areas consists of clay. Where the subgrade has a high clay content, it will be easily disturbed by construction equipment traffic when it is very moist to wet. Removal of the upper clay or placement of approximately 1 to 2 feet of granular borrow consisting predominantly of gravel with less than 15 percent passing the No. 200 sieve may be needed to provide limited access for rubber-tired equipment and to facilitate pavement construction where the subgrade has a high clay content and is very moist to wet. Consideration may be given to placing a support fabric over the subgrade prior to placing granular borrow.

5. Geotechnical information relating to foundations, subgrade preparation, materials and pavement is included in the report.

SCOPE

This report presents the results of a geotechnical investigation for the proposed Louisa May Alcott Community School at 1150 East 1200 North in Mapleton, Utah. The report presents the subsurface conditions encountered, laboratory test results and recommendations for foundations and pavement. The study was conducted in general accordance with our proposal dated June 11, 2026.

Field exploration was conducted to obtain information on the subsurface conditions at the site. Samples obtained from the field investigation were tested in the laboratory to determine physical and engineering characteristics of the on-site soil. Information obtained from the field and laboratory investigations was used to define conditions at the site and to develop recommendations for the proposed foundations and pavement.

This report has been prepared to summarize the data obtained during the study and to present our conclusions and recommendations based on the proposed construction and the subsurface conditions encountered. Design parameters and a discussion of geotechnical engineering considerations relating to construction are included in the report.

SITE CONDITIONS

The site is a cultivated field. There are no permanent structures or pavement on the site.

The site has a gentle slope down to the west-southwest.

There is an unlined irrigation ditch along the north side of the site that had water flowing in it at the time of our field study.

There is a vinyl fence that generally extends around the perimeter of the property but the property extends beyond the fence to the east. The area east of the fence appears to be disturbed and has mounded soil up to about 3 feet high.

The site has rows of cultivated crops. Areas that are not cultivated generally have grass and weeds. There are a few trees around the southern perimeter of the site.

There is a narrow asphalt-paved drive along the west and south sides of the site. The north side is bordered by 1200 North Street, which is a two-lane asphalt-paved road. The east side of the site is bordered by an asphalt-paved trail, which appears to follow the alignment of a canal, which is assumed to be in a buried pipe along the trail.

FIELD STUDY

The field study was conducted on June 19 and 22, 2026. Eight borings were drilled at the approximate locations indicated on Figure 1 using 8-inch-diameter hollow-stem auger. The borings were logged and soil samples obtained by an engineer from AGEC. Logs of the subsurface conditions encountered in the borings are graphically shown on Figures 2 and 3 with legend and notes on Figure 4.

A trench was excavated for a fault study on June 16, 2026 at the approximate location indicated on Figure 1 using a trackhoe. The findings of the fault study are presented in a separate report under Project No. 1260330. The trench was backfilled without compactive effort and not placed

uniformly or tested for compaction. The backfill in the trench should be removed and be properly compacted where it will support proposed buildings, slabs, pavements and other settlement-sensitive features planned for the site.

GEOPHYSICAL MEASUREMENTS

We performed geophysical surface wave measurements at the site, consisting of Multi-channel Analysis of Surface Waves (MASW) and Microtremor Array Measurements (MAM) on July 2, 2026. The approximate locations of the arrays are shown on Figure A1 in the Appendix.

The MASW was performed using a 150-foot long array of 24 evenly-spaced geophones. Active noise was generated by striking a 16-pound sledge hammer against a steel plate on both ends of the array. The MAM was performed using an L-shaped array, using 24 evenly-spaced geophones along 197- and 180-foot long legs. Ambient vibrations were recorded for approximately 1 hour.

The collective data from the MASW and MAM was processed into dispersion data and trimmed to generate an experimental dispersion curve, to serve as a target for inversion, as shown on Figure A2. A suite of hundreds of possible shear wave velocity profiles were generated to match the target dispersion curve, using the inversion process. The best-fit 100 profiles for each of the three inversion runs (parameterizations), along with the median velocity profile of each parameterization, are shown on Figure A3.

We calculate an average shear wave velocity value from the median model of each parameterization for the top approximately 100 feet ($V_{s,30}$) of 1,020 ± 20 feet per second, in general accordance with ASCE 7-22 § 20.4.1. Based on the calculated $V_{S,30}$ value, the site may be considered a Site Class CD as per ASCE 7-22 Chapter 20.

SUBSURFACE CONDITIONS

Approximately 1 foot of topsoil was encountered in the borings except for Boring B-6 where approximately 1 foot of fill was encountered. Clay was encountered below the topsoil to depths of approximately 1½, 2½, 3, 4½, 2½ and 3 feet in Borings B-2, B-3, B-4, B-5, B-7 and B-8, respectively. Gravel was encountered below the clay in these borings and below the topsoil and fill in Borings B-1 and B-6. The gravel extends to the full depth investigated, approximately 18 feet. Practical auger refusal was met at depths of approximately 18, 10, 6, 12 and 10 feet in Borings B-1 through B-5, respectively.

A description of the various soils encountered in the borings follows:

Fill - The fill consists of silty gravel with sand. It is slightly moist and brown.

Topsoil - The topsoil consists of sandy lean clay. It is moist, brown and contains roots.

Lean Clay with Sand - The clay contains moderate to large amounts of sand. It is stiff to very stiff, slightly moist to moist and brown.

Laboratory tests conducted on samples of the clay indicate has natural moisture contents of 11 to 18 percent and natural dry densities of 102 to 110 pounds per cubic foot (pcf).

Consolidation tests conducted on the clay indicates that the soil will compress a small to moderate amount with the addition of light to moderate loads. Results of the consolidation test are presented on Figures 5 and 6.

Poorly Graded Gravel with Silt and Sand - The gravel contains cobbles and occasional sand layers. It is dense to very dense, slightly moist and brown to light brown.

Laboratory tests conducted on samples of the gravel indicate it has natural moisture contents of 1 to 3 percent and natural dry densities of 115 to 117 pcf.

The results of a gradation test on the gravel are presented on Figure 7.

Results of the laboratory tests are summarized on Table I and are included on the logs of the borings.

SUBSURFACE WATER

No subsurface water was encountered in the borings to the maximum depth investigated, approximately 18 feet.

PROPOSED CONSTRUCTION

We understand that the proposed school building will be a two-story wood-frame structure with a slab-on-grade floor. We anticipate that the barn will be a single-story structure with slab-on-grade floor. The structural engineer indicates that the maximum building loads will be 3.5 kips per lineal foot and 60 kips.

We understand that paved parking areas will be constructed at the site. We anticipate that some of these areas will receive only passenger vehicle traffic. It is anticipated that some areas may receive delivery trucks, garbage trucks and buses. For these areas, we have assumed traffic consisting of ten buses and five delivery trucks per day and two garbage trucks per week.

If the proposed construction, building loads or anticipated traffic is significantly different from what is described above, we should be notified to reevaluate the recommendations given.

RECOMMENDATIONS

Based on the subsurface conditions encountered, laboratory test results and our understanding of the proposed construction, the following recommendations are given:

A. Site Grading

We anticipate relatively small amounts of cut and fill for the proposed construction. We anticipate that the main floor elevation will be within approximately 3 feet of existing grade.

1. Subgrade Preparation

Unsuitable fill, topsoil, organics, debris and other deleterious material should be removed from below the proposed building area and areas of other improvements such as pavement and exterior slabs.

The upper soil in some areas consists of clay. Where the subgrade has a high clay content, it will be easily disturbed by construction equipment traffic when it is very moist to wet. Removal of the upper clay or placement of approximately 1 to 2 feet of granular borrow consisting predominantly of gravel with less than 15 percent passing the No. 200 sieve may be needed to provide limited access for rubber-tired equipment and to facilitate pavement construction where the subgrade has a high clay content and is very moist to wet. Consideration may be given to placing a support fabric over the subgrade prior to placing granular borrow.

2. Excavation

We anticipate that excavation at the site can be accomplished with heavy-duty excavation equipment.

Temporary unretained excavations may be sloped at 1½ horizontal to 1 vertical or flatter.

3. Materials

Listed below are recommendations for imported structural fill.

Fill to Support	Recommendations
Footings	Non-expansive granular soil Passing No. 200 Sieve < 35% Liquid Limit < 30% Maximum size 4 inches
Floor Slab (Upper 4 inches)	Sand and/or Gravel Passing No. 200 Sieve < 5% Maximum size 2 inches
Slab Support	Non-expansive granular soil Passing No. 200 Sieve < 50% Liquid Limit < 30% Maximum size 6 inches

Materials placed as fill to support structures should be non-expansive granular soil. The natural gravel may be considered for reuse as structural fill if it meets the recommendations given above for imported structural fill and if the organics, debris, over-sized particles and other deleterious materials are removed. The on-site soils may be considered for use as site grading fill in pavement and exterior slab areas and as utility trench and wall backfill if the topsoil, organics, debris and other deleterious are removed or they may be used in landscape areas.

The on-site soil may require moisture conditioning (wetting or drying) prior to use as fill. Drying of the soil may not be practical during cold or wet periods of the year.

4. Compaction

Compaction of materials placed at the site should equal or exceed the minimum densities as indicated below when compared to the maximum dry density as determined by ASTM D 1557.

Fill To Support	Compaction
Foundations	≥ 95%
Concrete Flatwork	≥ 90%
Pavement	
Base Course	≥ 95%
Fill Placed Below Base Course	≥ 90%
Landscaping	≥ 85%
Retaining Wall Backfill	85 - 90%

To facilitate the compaction process, fill should be compacted at a moisture content within 2 percent of the optimum moisture content.

The fill should be placed and compacted in thin enough lifts to allow for proper compaction. Fill placed for the project should be frequently tested for compaction during construction.

5. Drainage

The ground surface surrounding the proposed buildings should be sloped away from the buildings in all directions. Roof downspouts and drains should discharge beyond the limits of backfill.

The collection and diversion of drainage away from the pavement surface is important to the satisfactory performance of the pavement section. Proper drainage should be provided.

B. Foundations

1. Bearing Material

With the proposed construction and the subsurface conditions encountered, the proposed building and barn may be supported on spread footings bearing on the undisturbed natural gravel or on compacted structural fill extending down to the undisturbed natural gravel.

Structural fill placed below footings should extend down to the undisturbed natural soil and out away from the edge of footings at least a distance equal to the depth of fill beneath footings.

Topsoil, organics, unsuitable fill and other deleterious materials should be removed from below proposed foundation areas.

2. Bearing Pressure

Spread footings bearing on the undisturbed natural gravel or on compacted structural fill may be designed using an allowable net bearing pressure of 3,500 pounds per square foot.

3. Settlement

We estimate that total settlement will be on the order of ½ inch for foundations designed as indicated above.

4. Temporary Loading Conditions

The allowable bearing pressure may be increased by one-half for temporary loading conditions such as wind or seismic loads.

5. Frost Depth

Exterior footings and footings beneath unheated areas should be placed at least 30 inches below grade for frost protection.

6. Foundation Base

The base of foundation excavations should be cleared of loose or deleterious material prior to structural fill or concrete placement.

7. Construction Observation

A representative of the geotechnical engineer should observe footing excavations prior to structural fill or concrete placement.

C. Concrete Slab-on-Grade

1. Slab Support

Concrete slabs may be supported on the undisturbed natural soil or on compacted structural fill extending down to the undisturbed natural soil.

Topsoil, organics, debris, unsuitable fill and other deleterious materials should be removed from below proposed floor slab areas.

2. Underslab Sand and/or Gravel

A 4-inch layer of free-draining sand and/or gravel (less than 5 percent passing the No. 200 sieve) should be placed below the concrete slabs for ease of construction and to promote even curing of the slab concrete.

3. Vapor Barrier

A vapor barrier should be placed under the concrete floor if the floor will receive an impermeable floor covering. The barrier will reduce the amount of water vapor passing from below the slab to the floor covering.

D. Lateral Earth Pressure

1. Lateral Resistance for Footings

Lateral resistance for spread footings placed the natural gravel or on compacted structural fill is controlled by sliding resistance between the footing and the structural fill or natural gravel. A friction value of 0.45 may be used in design for ultimate lateral resistance.

2. Subgrade Walls and Retaining Structures

The following equivalent fluid weights are given for the design of subgrade walls and retaining structures. The active condition is where the wall moves away from the soil. The passive condition is where the wall moves into the soil and the at-rest condition is where the wall does not move. The values listed below assume a horizontal surface adjacent the wall.

Soil Type	Active	At-Rest	Passive
Clay & Silt	50 pcf	65 pcf	250 pcf
Sand & Gravel	40 pcf	55 pcf	300 pcf

3. Seismic Conditions

Under seismic conditions, the equivalent fluid weight should be increased by 37 and 22 pcf for active and at-rest conditions, respectively, and decreased by 37 pcf

for the passive condition. This assumes a peak horizontal ground acceleration of 0.62g which represents a 2 percent probability of exceedance in a 50-year period.

4. Safety Factors

The values recommended above assume mobilization of the soil to achieve the soil strength under active and passive conditions. Conventional safety factors used for structural analysis for such items as overturning and sliding resistance should be used in design.

E. Seismicity, Faulting and Liquefaction

1. Seismicity

Listed below is a summary of the site parameters for the 2024 International Building Code:

Description	Value[1]
Site Class	CD[2]
S_{DS} - design spectral acceleration (period=0.2s)	0.98g
S_{D1} - design spectral acceleration (period=1.0s)	0.62g
PGA_M - Site modified peak ground acceleration	0.62g

[1]Values obtained from information provided by the ASCE Hazard Tool at https://ascehazardtool.org

[2]Site Class CD was selected based on measuring the shear wave velocity using MASW and MAM. An average shear wave velocity for the top 100 feet ($V_{s,30}$) of 1,020 ± 20 feet per second was measured.

2. Faulting

There are no mapped active faults extending through the project site. The closest mapped fault, which is considered active, is the Wasatch Fault, which has mapped traces extending approximately 400 feet northeast of the site (Utah Geological

Survey, 2026). The site is within an area mapped as a fault special study area. A fault study was conducted by AGEC and our findings are presented in a report under Project No. 1260330. No evidence of fault offset was identified in the trench excavated at the site.

3. Liquefaction

The site is located in an area mapped as having a "moderate" liquefaction potential (Anderson and others, 1994). The soil type most susceptible to liquefaction during a large magnitude earthquake is loose, clean sand. The liquefaction potential tends to decrease with an increase in fines content and density.

Based on subsurface conditions encountered and our understanding of the geology of the site, liquefaction is not considered to be a hazard at this site.

F. Water Soluble Sulfates

One sample of the natural soil was tested in the laboratory for water soluble sulfate content. Based on the test results, published literature and previous experience in the area, the natural soil possesses negligible sulfate attack potential on concrete. No special cement type is required for concrete placed in contact with the soil. Other conditions may dictate the type of cement to be used in concrete for the project.

G. Pavement

Based on the subsurface conditions encountered, laboratory test results and the assumed traffic, the following pavement support recommendations are given:

1. Subgrade Support

The near surface soil consists of clay overlying gravel. A California Bearing Ratio (CBR) value of 3 percent was used in the analysis which assumes a clay subgrade.

2. Pavement Thickness

Based on the subsoil conditions, assumed traffic, a design life of 20 years for flexible pavement and 30 years for rigid pavement and methods presented by AASHTO, the following pavement sections are calculated:

	Rigid Pavement	Flexible Pavement		
Traffic	Portland Cement Concrete	Asphaltic Concrete	Base Course	Granular Borrow
Passenger Vehicles	5"	—	—	—
	—	3"	6"	—
Truck/Bus Areas	5"	—	—	—
	—	3½"	6"	9"

Approximately 1 to 2 feet of granular borrow or removal of the upper clay may be needed for construction equipment access and to facilitate pavement construction when the subgrade is very moist to wet soil with a high clay content.

Granular borrow may be eliminated for truck areas where the subgrade consists of at least 9 inches of the natural gravel.

A pavement section consisting of 6½ inches of Portland cement concrete overlying 4 inches of base course is recommended for dumpster approach slabs.

3. Pavement Materials and Construction

a. Flexible Pavement (Asphaltic Concrete)

The pavement materials should meet the specifications for the applicable jurisdiction. Other materials may be considered for use in the pavement section. The use of other materials may result in the need for different pavement material thicknesses.

b. Rigid Pavement (Portland Cement Concrete)

The rigid pavement thickness given above assumes that the pavement will have aggregate interlock joints and that a concrete shoulder or curb will be provided.

The pavement materials should meet the specifications for the applicable jurisdiction. The pavement thickness indicated above assumes that the concrete will have a 28-day compressive strength of 5,000 pounds per square inch. Concrete should be air entrained with approximately 6 percent air. Maximum allowable slump will depend on the method of placement but should not exceed 4 inches.

4. Jointing

Joints for concrete pavement should be laid out in a square or rectangular pattern. Joint spacings should not exceed 30 times the thickness of the slab or 15 feet, whichever is smallest. The joint spacings indicated should accommodate the contraction of the concrete and under these conditions steel reinforcing will not be required. The depth of joints should be approximately one-fourth of the slab thickness.

H. Continuing Services

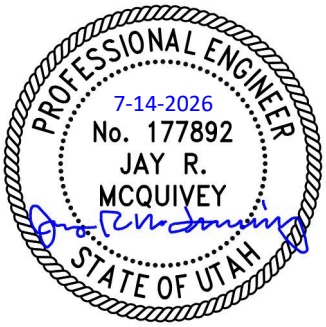
A preconstruction meeting should be held with representatives of the owner, project architect, geotechnical engineer, general contractor, earthwork contractor and other members of the design team to review construction plans, specifications, methods and schedule.

The geotechnical engineer should observe the excavation, earthwork, and foundation phases of the work to determine that subsurface conditions are consistent with those used in the analysis and design. The work should be observed and tested to determine that proper compaction has been achieved during site grading and placement of structural fill.

LIMITATIONS

This report has been prepared in accordance with generally accepted soil and foundation engineering practices in the area for the use of the client for design purposes. The conclusions and recommendations included within the report are based on the information obtained from the borings drilled at the approximate locations indicated on Figure 1, the results of laboratory tests and our experience in the area. Variations in the subsurface conditions may not become evident until additional exploration or excavation is conducted. If the subsurface conditions, proposed construction or groundwater level is found to be significantly different from what is described above, we should be notified to reevaluate the recommendations given.

APPLIED GEOTECHNICAL ENGINEERING CONSULTANTS, INC.



Jay R. McQuivey, P.E.

Reviewed by Douglas R. Hawkes, P.E., P.G.

JRM/rs

REFERENCES

American Society of Civil Engineers, 2022. "Minimum Design Loads and Associated Criteria for Buildings and Other Structures" ASCE/SEI 7-22

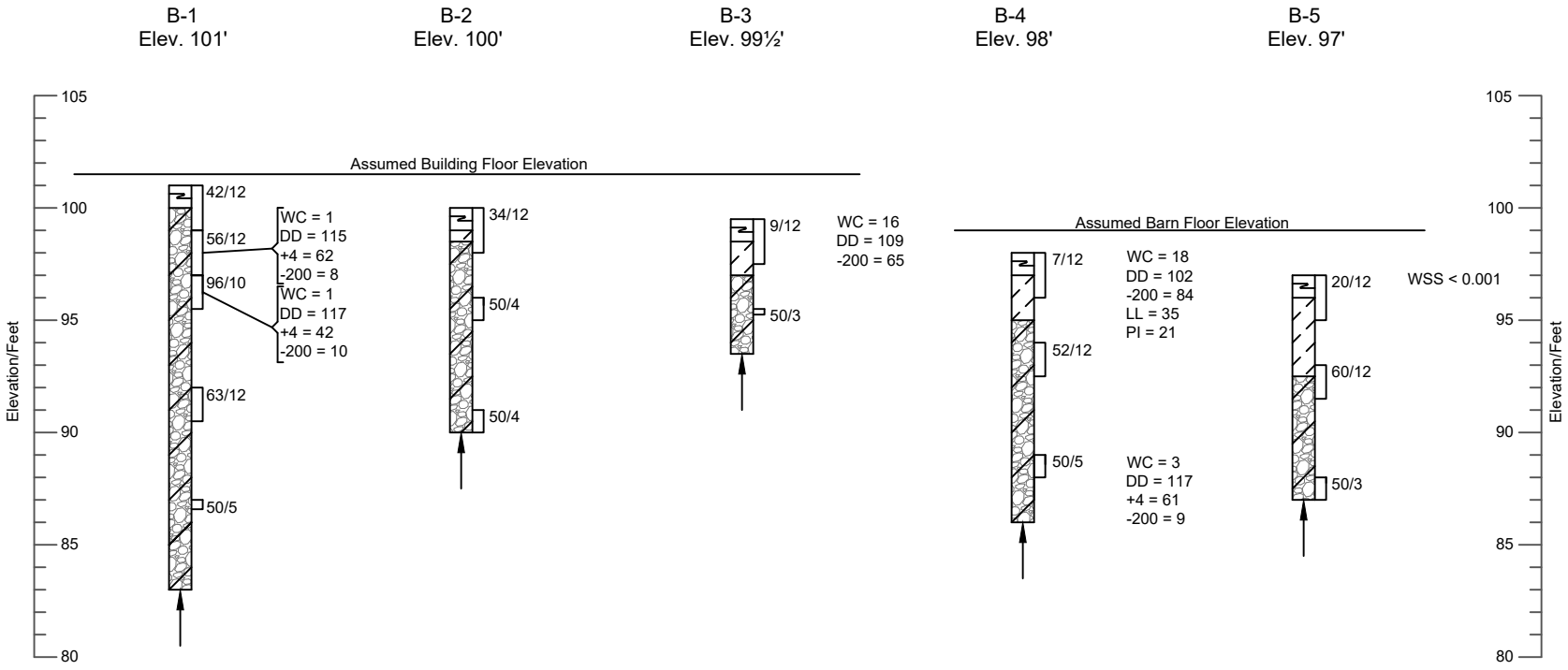
Anderson, L. R., Keaton, J. R. and Bischoff, J. E., 1994; Liquefaction Potential Map for Utah County, Utah Geological Survey Contract Report 94-8.

International Code Council, 2023; 2024 International Building Code, Washington, D.C.

Utah Geological Survey, 2026; Utah Geologic Hazards Portal accessed June 30, 2026 at https://geology.utah.gov/apps/hazards/

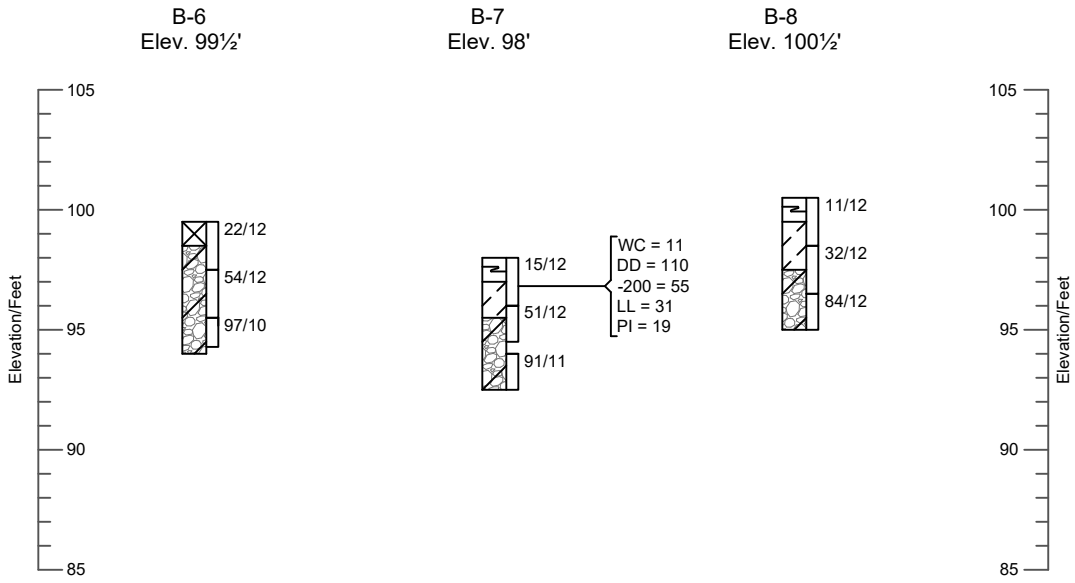
LOUISA MAY ALCOTT COMMUNITY SCHOOL
1150 EAST 1200 NORTH
MAPLETON, UTAH

1260315	AGEC	Exploratory Boring and Fault Trench Locations	Figure 1



See Figure 4 for Legend and Notes

1260315	AGEC	Exploratory Boring Logs	Figure 2



See Figure 4 for Legend and Notes

1260315	AGEC	Exploratory Boring Logs	Figure 3

LEGEND:

Fill; silty gravel with sand, slightly moist, brown.

Topsoil; sandy lean clay, moist, brown, roots.

Lean Clay with Sand (CL); moderate to large amount of sand, stiff to very stiff, slightly moist to moist, brown.

Poorly Graded Gravel with Silt and Sand (GP-GM); cobbles, occasional sand layers, dense to very dense, slightly moist, brown to light brown.

10/12 California Drive sample taken. The symbol 10/12 indicates that 10 blows from a 140-pound automatic hammer falling 30 inches were required to drive the sampler 12 inches.

Indicates practical auger refusal.

NOTES:

1. The borings were drilled on June 19 and 22, 2026 with 8-inch-diameter hollow-stem auger.
2. Locations of the borings were measured approximately by pacing from features shown on Figure 1.
3. Elevations of the borings were measured by automatic level and refer to the benchmark shown on Figure 1.
4. The boring locations and elevations should be considered accurate only to the degree implied by the method used.
5. The lines between materials shown on the boring logs represent the approximate boundaries between material types and the transitions may be gradual.
6. No free water was encountered in the borings at the time of drilling.
7. WC = Water Content (%);
   DD = Dry Density (pcf);
   +4 = Percent Retained on the No. 4 Sieve;
   -200 = Percent Passing the No. 200 Sieve;
   LL = Liquid Limit (%);
   PI = Plasticity Index (%);
   WSS = Water Soluble Sulfates (%).

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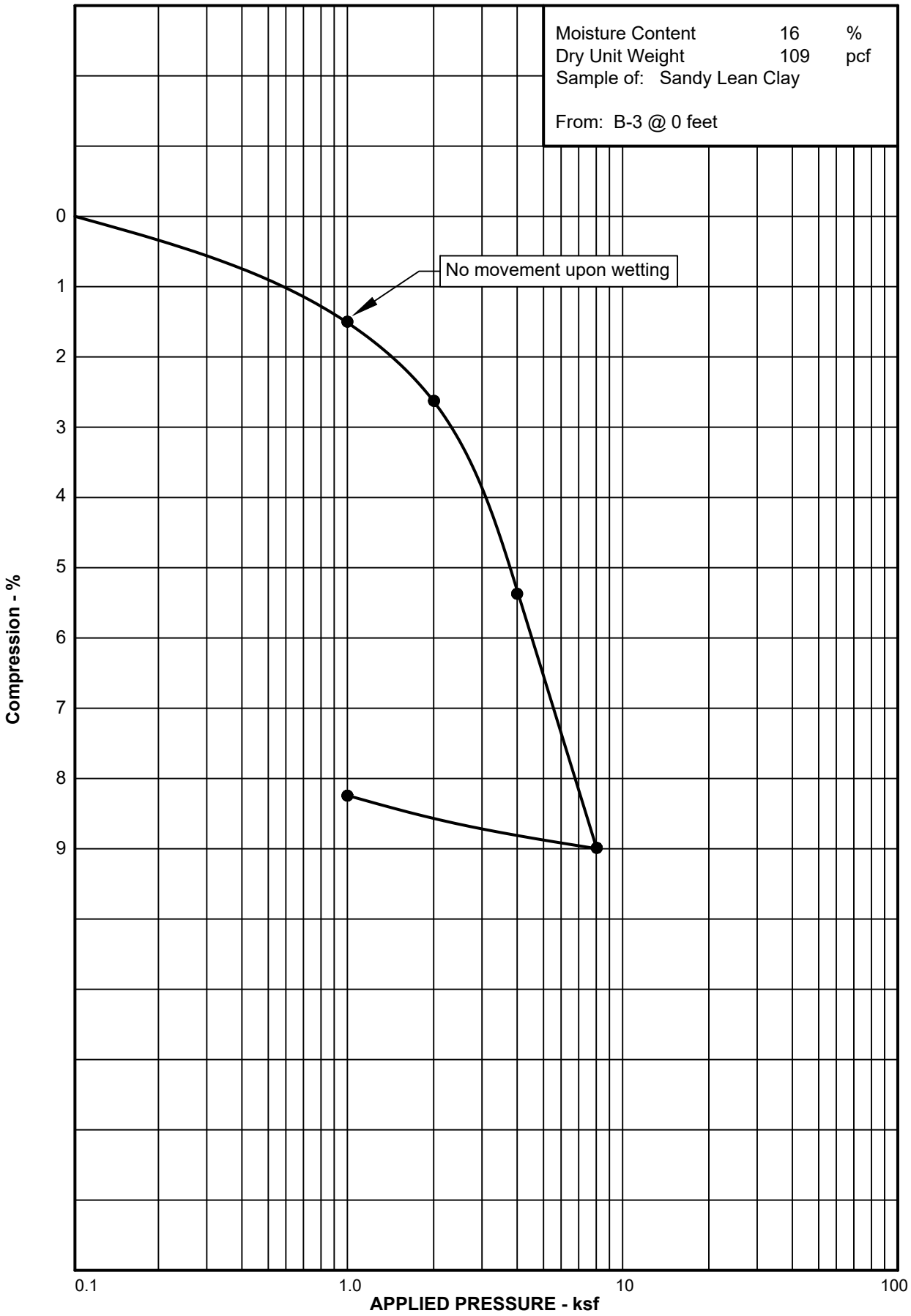
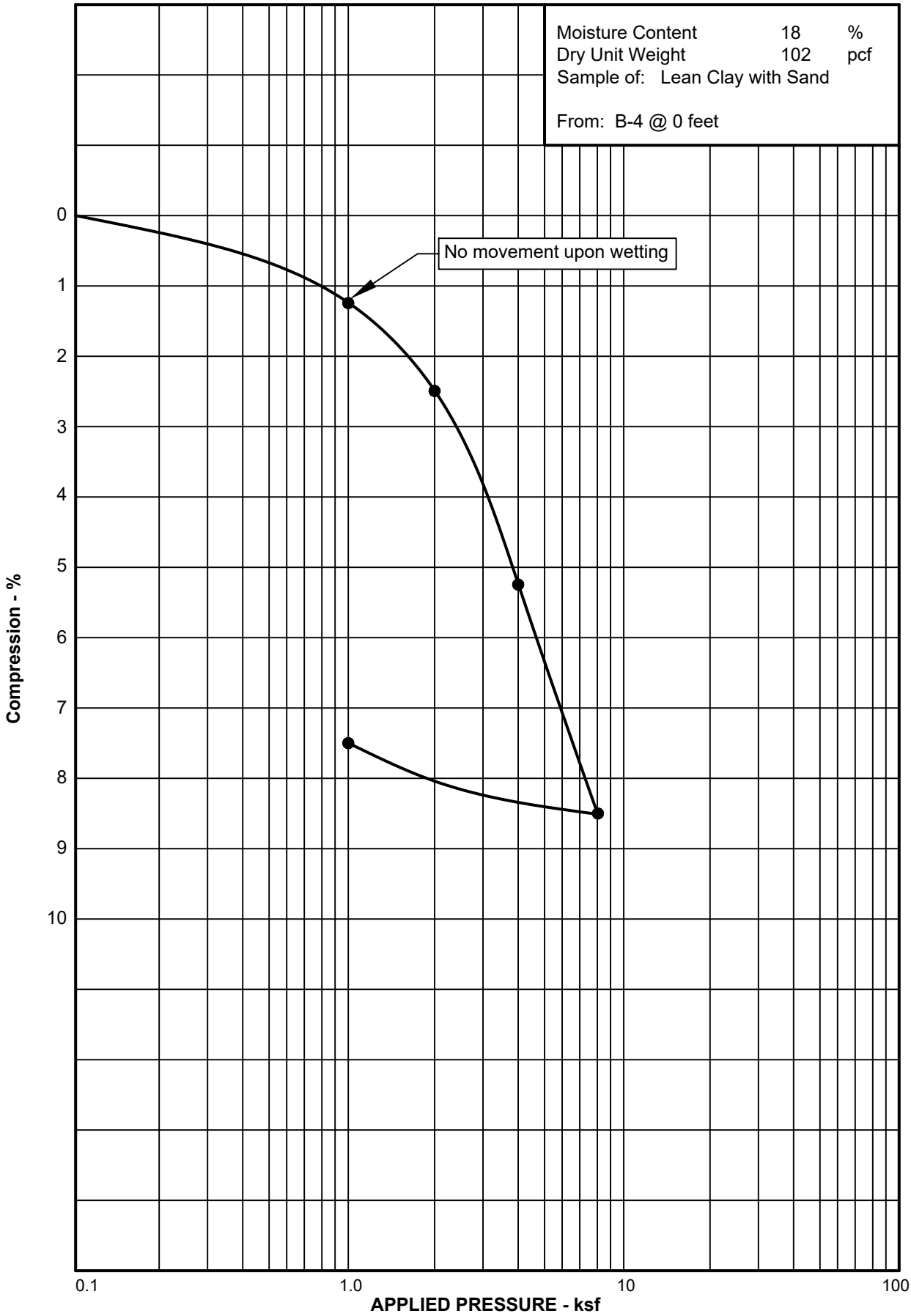


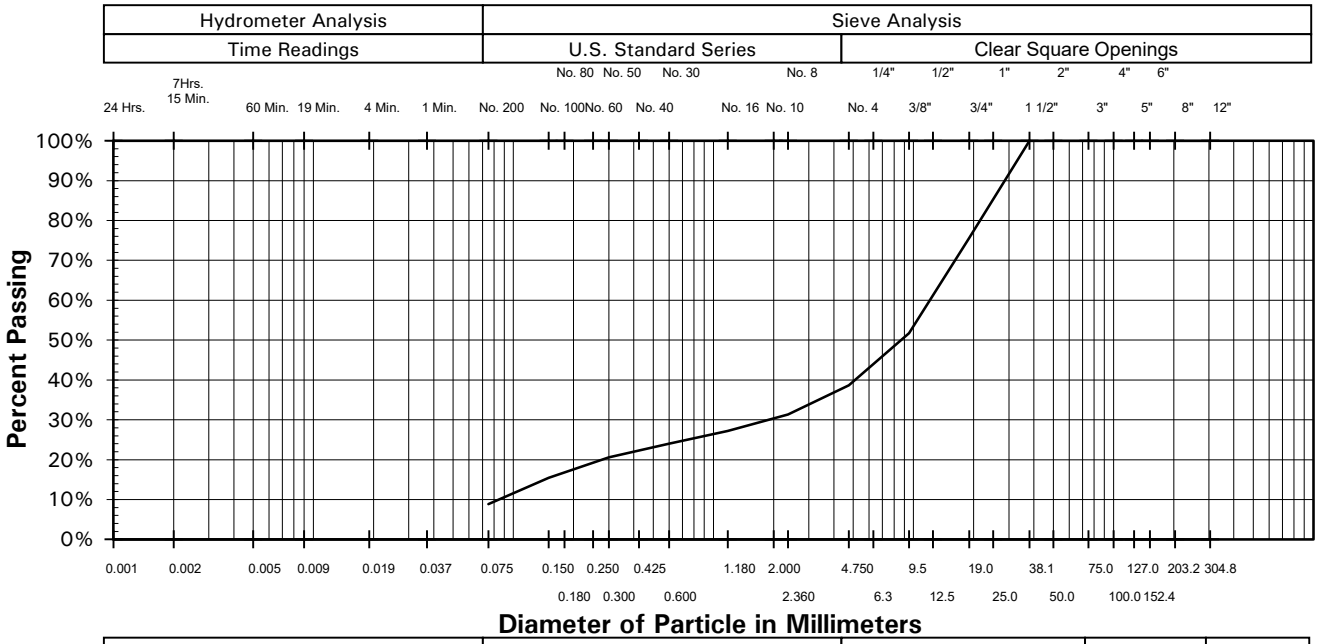
Project No. 1260315 **CONSOLIDATION TEST RESULTS** **Figure 5**

Applied Geotechnical Engineering Consultants



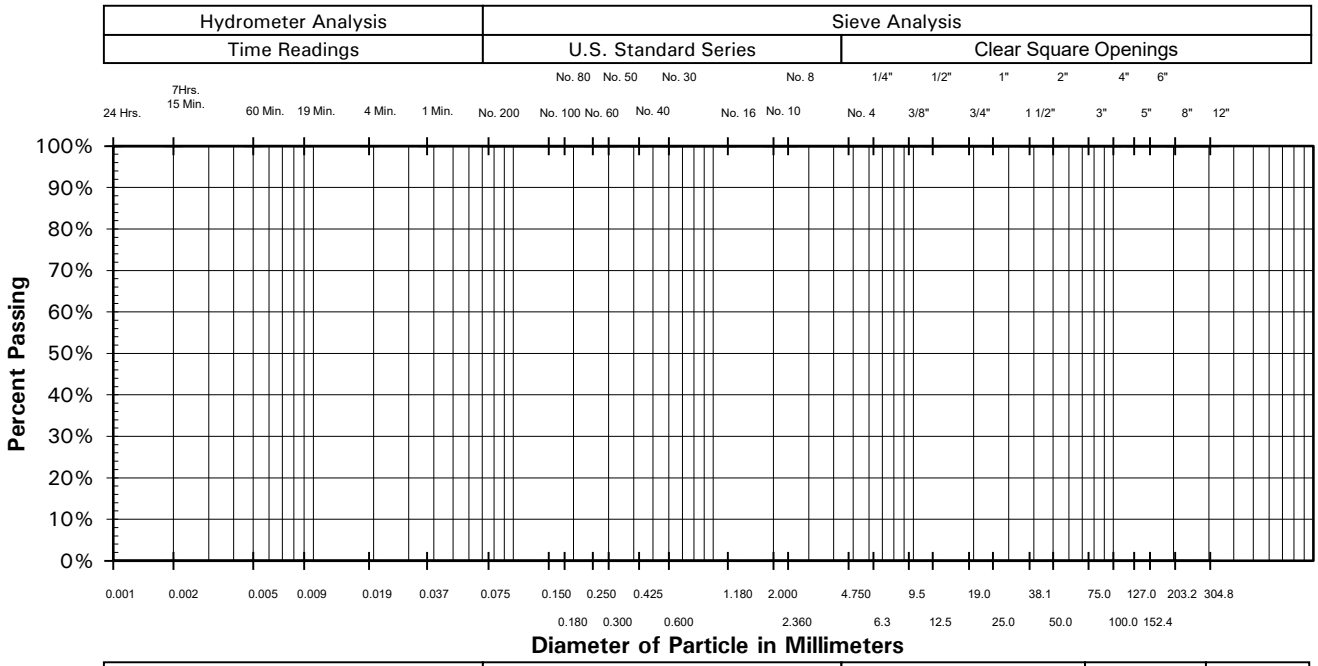
Project No. 1260315 **CONSOLIDATION TEST RESULTS** **Figure 6**

APPLIED GEOTECHNICAL ENGINEERING CONSULTANTS, INC.



Clay to Silt	Sand			Gravel		Cobbles	Boulders
	Fine	Medium	Coarse	Fine	Coarse		

Gravel	61%	Liquid Limit	-
Sand	30%	Plasticity Index	-
Silt and Clay	9%	Sample Location	B-4 @ 9 feet
Sample Description	Poorly Graded Gravel with Silt and Sand		



Clay to Silt	Sand			Gravel		Cobbles	Boulders
	Fine	Medium	Coarse	Fine	Coarse		

Gravel	-	Liquid Limit	-
Sand	-	Plasticity Index	-
Silt and Clay	-	Sample Location	
Sample Description			

Project No. 1260315 **GRADATION TEST RESULTS** Figure 7

APPLIED GEOTECHNICAL ENGINEERING CONSULTANTS, INC.

TABLE I
SUMMARY OF LABORATORY TEST RESULTS

PROJECT NUMBER: 1260315

SAMPLE LOCATION		NATURAL MOISTURE CONTENT (%)	NATURAL DRY DENSITY (PCF)	GRADATION			ATTERBERG LIMITS		UNCONFINED COMPRESSIVE STRENGTH (PSF)	WATER SOLUBLE SULFATE (%)	SAMPLE CLASSIFICATION
BORING	DEPTH (FEET)			GRAVEL (%)	SAND (%)	SILT/ CLAY (%)	LIQUID LIMIT (%)	PLASTICITY INDEX			
B-1	2	1	115	62	30	8					Poorly Graded Gravel with Silt and Sand (GP-GM)
	4	1	117	42	48	10					Poorly Graded Sand with Silt and Gravel (SP-SM)
B-3	0	16	109			65					Sandy Lean Clay (CL)
B-4	0	18	102			84	35	21			Lean Clay with Sand (CL)
	9	3	117	61	30	9					Poorly Graded Gravel with Silt and Sand (GP-GM)
B-5	0									< 0.001	Lean Clay with Sand (CL)
B-7	0	11	110			55	31	19			Sandy Lean Clay (CL)

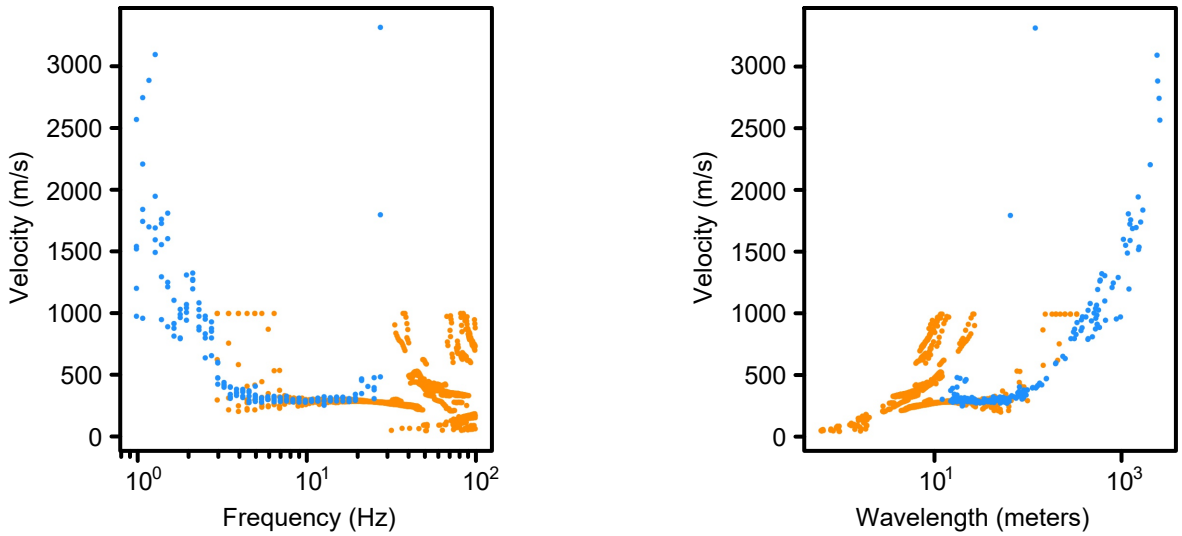
APPENDIX

MULTI-CHANNEL ANALYSIS OF SURFACE WAVES (MASW)
AND
MICROTREMOR ARRAY MEASUREMENTS (MAM)

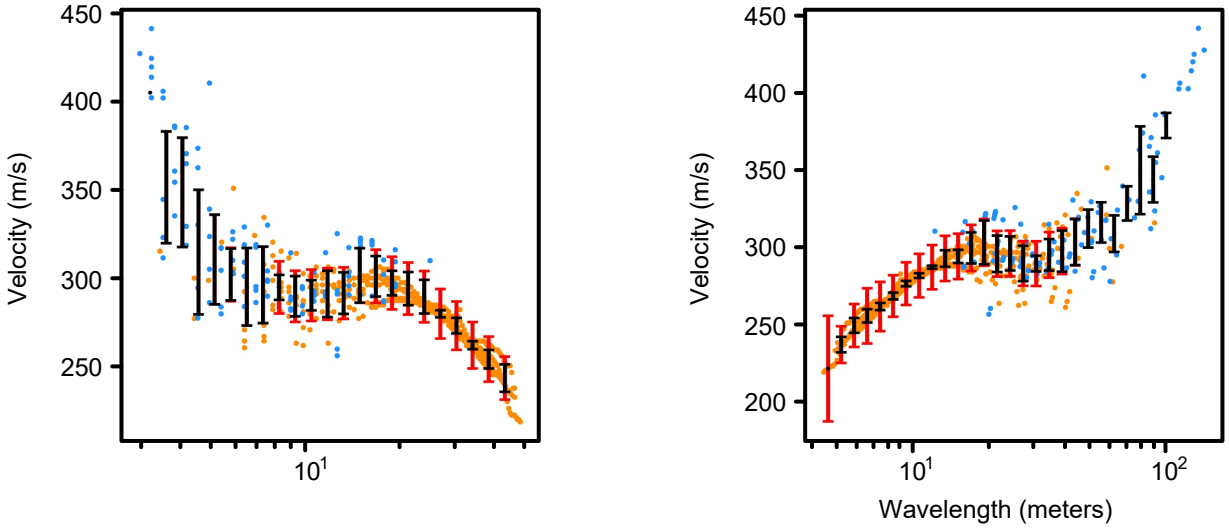
1260315	AGEC	Exploratory Boring, Surface Wave Array, and Fault Trench Locations	Figure A1

Applied Geotechnical Engineering Consultants, Inc.

a) **RAW DATA**



b) **TRIMMED DATA**



LEGEND:

- MASW
- MAM
- ----- Limits
- Target Experimental Dispersion Data
- Target Experimental Dispersion Data (min COV=0.05)

Project Name: Louisa May Alcott Community School

Measurement Method: Multi-channel Analysis of Surface Waves (MASW)
Microtremor Array Measurement (MAM)

Location: MASW-1 and MAM-1

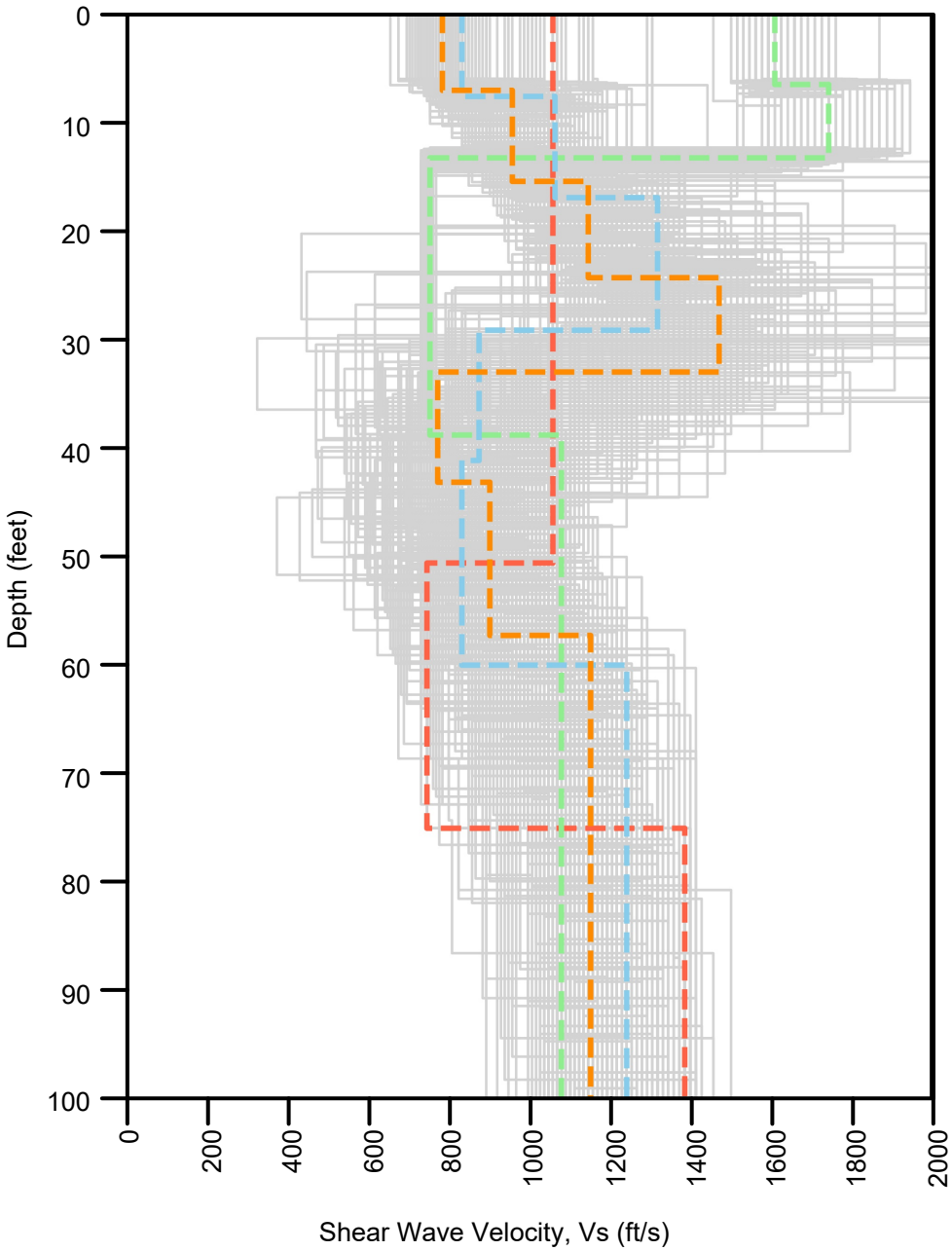
Date of Test: July 2, 2026

Project No. 1260315

PEAK DISPERSION DATA

Figure A2

Applied Geotechnical Engineering Consultants, Inc.



LEGEND:
- Median of Parametrization 1
- Median of Parametrization 2
- Median of Parametrization 3
- Median of Parametrization 4
- Best 100 Models for each Parameterization

Project Name: Louisa May Alcott Community School
Measurement Method: Multi-channel Analysis of Surface Waves (MASW)
Microtremor Array Measurement (MAM)

V_{S30}: 1,020 ± 20 ft/s
Location: MASW-1 and MAM-1

Date of Test: July 2, 2026

Project No. 1260315 **SHEAR WAVE VELOCITY PROFILES** **Figure A3**

SECTION 01 10 00 - SUMMARY

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Project information.
2. Work covered by Contract Documents.
3. Contractor's use of site and premises.
4. Coordination with occupants.
5. Work restrictions.
6. Specification and Drawing conventions.
7. Miscellaneous provisions.

B. Related Requirements:

1. Section 015000 "Temporary Facilities and Controls" for limitations and procedures governing temporary use of Owner's facilities.

1.2 PROJECT INFORMATION

A. Project Identification: Louisa May Alcott Community School.

1. Project Location: Approximately 1250 East 1200 North, Mapleton, UT 84664.

B. Owner: Louisa May Alcott Community School.

1. Owner's Representative: Carrie Ashcraft.

C. Architect: Babcock Design .

1. Architect's Representative: Ricky Parkinson or Wes Baker .

D. Architect's Consultants: Architect has retained the following design professionals, who have prepared designated portions of the Contract Documents:

1. Structural Engineer : BHB Structural .

   a. Structural Engineer Representative: Chris Bratt .

2. Electrical Engineer: Lynk Engineers

   a. Electrical Engineer Representative: Scott Kingery

3. Mechanical/Plumbing Engineer: Lynk Engineers

   a. Mechanical/Plumbing Engineer Representatives: Reg Hamilton and/or Danette Marcoccia

4. Civil Engineer: Ensign Engineering

   a. Civil Engineer Representative: Corey Child

E. Contractor: Stout LLC has been engaged as Contractor for this Project.

1. Contractor Representative: Aaron Halley .

1.3 WORK COVERED BY CONTRACT DOCUMENTS

A. The Work of Project is defined by the Contract Documents and includes, but is not limited to, the following:

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1. A new 24,000 sf 2-story classroom building, an 8,100 sf pole barn building used as a gymnasium, cafeteria, and classroom spaces, along with associated site improvements including parking areas, sidewalk, playground areas, etc. and other Work indicated in the Contract Documents.

B. Type of Contract:

1. Project will be constructed under a single prime contract.

1.4 CONTRACTOR'S USE OF SITE AND PREMISES

A. Limits on Use of Site: Limit use of Project site to areas within the Contract limits indicated. Do not disturb portions of Project site beyond areas in which the Work is indicated.

1. Driveways, Walkways and Entrances: Keep driveways and entrances serving premises clear and available to Owner, Owner's employees, and emergency vehicles at all times. Do not use these areas for parking or for storage of materials.

a. Schedule deliveries to minimize use of driveways and entrances by construction operations.
b. Schedule deliveries to minimize space and time requirements for storage of materials and equipment on-site.

B. Condition of Existing Building: Maintain portions of existing building affected by construction operations in a weathertight condition throughout construction period. Repair damage caused by construction operations.

C. Condition of Existing Grounds: Maintain portions of existing grounds, landscaping, and hardscaping affected by construction operations throughout construction period. Repair damage caused by construction operations.

1.5 COORDINATION WITH OCCUPANTS

A. Owner Limited Occupancy of Completed Areas of Construction: Owner reserves the right to occupy and to place and install equipment in completed portions of the Work, prior to Substantial Completion of the Work, provided such occupancy does not interfere with completion of the Work. Such placement of equipment and limited occupancy shall not constitute acceptance of the total Work.

1. Architect will prepare a Certificate of Substantial Completion for each specific portion of the Work to be occupied prior to Owner acceptance of the completed Work.
2. Obtain a Certificate of Occupancy from authorities having jurisdiction before limited Owner occupancy.
3. Before limited Owner occupancy, mechanical and electrical systems shall be fully operational, and required tests and inspections shall be successfully completed. On occupancy, Owner will operate and maintain mechanical and electrical systems serving occupied portions of Work.
4. On occupancy, Owner will assume responsibility for maintenance and custodial service for occupied portions of Work.

1.6 WORK RESTRICTIONS

A. Comply with restrictions on construction operations.

1. Comply with limitations on use of public streets, work on public streets, rights of way, and other requirements of authorities having jurisdiction.

B. Existing Utility Interruptions: Do not interrupt utilities serving facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging for temporary utility services according to requirements indicated:

1. Notify Owner not less than two days in advance of proposed utility interruptions.

C. Noise, Vibration, Dust, and Odors: Coordinate operations that may result in high levels of noise and vibration, dust, odors, or other disruption to Owner occupancy with Owner.

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1. Notify Owner not less than two days in advance of proposed disruptive operations.

D. Smoking and Controlled Substance Restrictions: Use of tobacco products , alcoholic beverages, and other controlled substances on Project site is not permitted.

1.7 SPECIFICATION AND DRAWING CONVENTIONS

A. 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:

1. Imperative mood and streamlined language are generally used in the Specifications. The words "shall," "shall be," or "shall comply with," depending on the context, are implied where a colon (:) is used within a sentence or phrase.
2. Text Color: Text used in the Specifications, including units of measure, manufacturer and product names, and other text may appear in multiple colors or underlined as part of a hyperlink; no emphasis is implied by text with these characteristics.
3. Hypertext: Text used in the Specifications may contain hyperlinks. Hyperlinks may allow for access to linked information that is not residing in the Specifications. Unless otherwise indicated, linked information is not part of the Contract Documents.
4. Specification requirements are to be performed by Contractor unless specifically stated otherwise.

B. Division 01 General Requirements: Requirements of Sections in Division 01 apply to the Work of all Sections in the Specifications.

C. Drawing Coordination: Requirements for materials and products identified on Drawings are described in detail in the Specifications. One or more of the following are used on Drawings to identify materials and products:

1. Terminology: Materials and products are identified by the typical generic terms used in the individual Specifications Sections.
2. Abbreviations: Materials and products are identified by abbreviations scheduled on Drawings .
3. Keynoting: Materials and products are identified by reference keynotes referencing Specification Section numbers found in this Project Manual.

PART 2 - PRODUCTS (Not Used)
PART 3 - EXECUTION (Not Used)

END OF SECTION 01 10 00

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SECTION 01 21 00 - ALLOWANCES

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes administrative and procedural requirements governing allowances.

B. Types of allowances include the following:

1. Lump-sum allowances.
2. Unit-cost allowances.
3. Quantity allowances.
4. Contingency allowances.
5. Testing and inspecting allowances.

C. Related Requirements:

1. Section 012600 "Contract Modification Procedures" for procedures for submitting and handling Change Orders.
2. Section 014000 "Quality Requirements" for procedures governing the use of allowances for field testing by an independent testing agency.

1.2 DEFINITIONS

A. Allowance: A quantity of work or dollar amount included in the Contract, established in lieu of additional requirements, used to defer selection of actual materials and equipment to a later date when direction will be provided to Contractor. If necessary, additional requirements will be issued by Change Order.

1.3 SELECTION AND PURCHASE

A. At the earliest practical date after award of the Contract, advise Architect of the date when final selection, or purchase and delivery, of each product or system described by an allowance must be completed by the Owner to avoid delaying the Work.

B. At Architect's request, obtain proposals for each allowance for use in making final selections. Include recommendations that are relevant to performing the Work.

C. Purchase products and systems selected by Architect from the designated supplier.

1.4 ACTION SUBMITTALS

A. Submit proposals for purchase of products or systems included in allowances in the form specified for Change Orders.

1.5 INFORMATIONAL SUBMITTALS

A. Submit invoices or delivery slips to show actual quantities of materials delivered to the site for use in fulfillment of each allowance.

B. Submit time sheets and other documentation to show labor time and cost for installation of allowance items that include installation as part of the allowance.

C. Coordinate and process submittals for allowance items in same manner as for other portions of the Work.

1.6 LUMP-SUM ALLOWANCES

A. Allowance shall include cost to Contractor of specific products and materials ordered by Owner or

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selected by Architect under allowance and shall include taxes, freight , and delivery to Project site.

B. Unless otherwise indicated, Contractor's costs for receiving and handling at Project site, labor, installation, overhead and profit, and similar costs related to products and materials ordered by Owner or selected by Architect under allowance shall be included as part of the Contract Sum and not part of the allowance.

C. Unused Materials: Return unused materials purchased under an allowance to manufacturer or supplier for credit to Owner, after installation has been completed and accepted.

1. If requested by Architect, retain and prepare unused material for storage by Owner. Deliver unused material to Owner's storage space as directed.

1.7 UNIT-COST ALLOWANCES

A. Allowance shall include cost to Contractor of specific products and materials ordered by Owner or selected by Architect under allowance and shall include taxes, freight , and delivery to Project site.

B. Unless otherwise indicated, Contractor's costs for receiving and handling at Project site, labor, installation, overhead and profit, and similar costs related to products and materials ordered by Owner or selected by Architect under allowance shall be included as part of the Contract Sum and not part of the allowance.

C. Unused Materials: Return unused materials purchased under an allowance to manufacturer or supplier for credit to Owner, after installation has been completed and accepted.

1. If requested by Architect, retain and prepare unused material for storage by Owner. Deliver unused material to Owner's storage space as directed.

1.8 QUANTITY ALLOWANCES

A. Allowance shall include cost to Contractor of specific products and materials ordered by Owner or selected by Architect under allowance and shall include taxes, freight , and delivery to Project site.

B. Unless otherwise indicated, Contractor's costs for receiving and handling at Project site, labor, installation, overhead and profit, and similar costs related to products and materials ordered by Owner or selected by Architect under allowance shall be included as part of the Contract Sum and not part of the allowance.

C. Unused Materials: Return unused materials purchased under an allowance to manufacturer or supplier for credit to Owner, after installation has been completed and accepted.

1. If requested by Architect, retain and prepare unused material for storage by Owner. Deliver unused material to Owner's storage space as directed.

1.9 ADJUSTMENT OF ALLOWANCES

A. Allowance Adjustment: To adjust allowance amounts, prepare a Change Order proposal based on the difference between purchase amount and the allowance, multiplied by final measurement of work-in-place where applicable. If applicable, include reasonable allowances for cutting losses, tolerances, mixing wastes, normal product imperfections, required maintenance materials, and similar margins.

1. Include installation costs in purchase amount only where indicated as part of the allowance.
2. If requested, prepare explanation and documentation to substantiate distribution of overhead costs and other markups.
3. Submit substantiation of a change in scope of Work, if any, claimed in Change Orders related to unit-cost allowances.
4. Owner reserves the right to establish the quantity of work-in-place by independent quantity survey, measure, or count.

B. Submit claims for increased costs due to a change in the scope or nature of the allowance described in the Contract Documents, whether for the purchase order amount or Contractor's handling, labor, installation, overhead, and profit.

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1. Do not include Contractor's or subcontractor's indirect expense in the Change Order cost amount unless it is clearly shown that the nature or extent of Work has changed from what could have been foreseen from information in the Contract Documents.
2. No change to Contractor's indirect expense is permitted for selection of higher- or lower-priced materials or systems of the same scope and nature as originally indicated.

PART 2 - PRODUCTS (Not Used)
PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine products covered by an allowance promptly on delivery for damage or defects. Return damaged or defective products to manufacturer for replacement.

3.2 PREPARATION

A. Coordinate materials and their installation for each allowance with related materials and installations to ensure that each allowance item is completely integrated and interfaced with related work.

3.3 SCHEDULE OF ALLOWANCES

A. Allowance No. 1 : Lump-Sum Allowance: Include the sum of $20,000 . Include Interior window blinds or roller shades.

1. This allowance includes material cost receiving, handling, and installation and Contractor overhead and profit.

END OF SECTION 01 21 00

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SECTION 01 23 00 - ALTERNATES

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes administrative and procedural requirements for alternates.

1.2 DEFINITIONS

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

1. Alternates described in this Section are part of the Work only if enumerated in the Agreement.
2. The cost or credit for each alternate is the net addition to or deduction from the Contract Sum to incorporate alternates into the Work. No other adjustments are made to the Contract Sum.

1.3 PROCEDURES

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

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

B. Execute accepted alternates under the same conditions as other Work of the Contract.

C. Schedule: A Part 3 "Schedule of Alternates" Article is included at the end of this Section. Specification Sections referenced in schedule contain requirements for materials necessary to achieve the work described under each alternate.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION

3.1 SCHEDULE OF ALTERNATES

A. **Alternate No. 01: Weather Barrier.**

1. Base Bid: Fluid-applied air barrier - as specified in Section 07 27 26 " Fluid Applied Membrane Air Barrier."
2. Alternate: Building Wrap - as specified in Section 07 25 00 " Weather Barriers."

B. **Alternate No. 02: Exterior Concrete Patio Outside Door 150b**

1. Base Bid: Provide a 5’x5’ concrete landing at door and leave the remaining area as rough grading for the owner landscape or make other improvements.
2. Alternate: Install concrete patio in size and configuration as shown on C-200.

C. **Alternate No. 03: Classroom Millwork**

1. Base Bid: Install classroom casework only in classrooms indicated to have a sink (Classrooms 123, 129, 162, 163, 223, 229, & 263).
2. Alternate: Install similar casework to base bid in remaining classrooms (Classrooms 122, 124, 128, 130, 222, 224 228, 230, & 264).

D. **Alternate No, 04: Coat Hook Millwork in Classrooms**

1. Base Bid: No coat hook millwork provided.

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2. Alternate: Coat hook millwork provided in classrooms and corridors as indicated on the plans – see Keynote 3 on A112 and A122 as well as Keynote 4 on sheet A403.

E. **Alternate No, 05: Mass Timber Ceiling Beams in Lobby and Library**

1. Base Bid: Install decorative wood beams in the ceiling space of Foyer 102 and Library 141/142 – see Keynote 6 on sheet A112, for locations, Detail E1/A403 and other associated details.
2. Alternate: Provide a deductive price to eliminate the decorative beams.

F. **Alternate No, 06: Fireplace in Foyer 102**

1. Base Bid: Install fireplace insert, framing, and finishes around fireplace as indicated in the drawings – see Keynote 6 on sheet A123 and additional elevations and details on sheet A402. See electrical drawings for power requirements. Coordinate with mechanical and plumbing requirements.
2. Alternate: Provide a deductive price to eliminate the fireplace, and associated framing. MEP connections to remain.

G. **Alternate No, 07: Gym 301 Flooring**

1. Base Bid: Provide sealed concrete SC-1 in Gym 301 with game line striping as shown on sheet A151.
2. Alternate: Provide sports flooring RFL-01 in Gym 301 with game line striping as shown on sheet A151. See Section 09 65 66 Resilient Athletic Flooring for additional criteria.

H. **Alternate No, 08: Pole Barn Flooring**

1. Base Bid: Provide flooring in all areas of the pole bard as indicated in the drawings except for Gym 301 per Alternate No, 07 above.
2. Alternate: Provide a deductive price to replace all flooring (exception in Gym 301) with sealed concrete SC-1.

END OF SECTION 01 23 00

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SECTION 01 25 00 - SUBSTITUTION PROCEDURES

PART 1 - GENERAL

1.1 SUMMARY

A. The Work of This Section Includes: Administrative and procedural requirements for substitutions.

B. Related Requirements:

1. Section 012100 "Allowances" for products selected under an allowance.
2. Section 012300 "Alternates" for products selected under an alternate.
3. Section 016000 "Product Requirements" for requirements for submitting comparable product submittals for products by listed manufacturers.

1.2 DEFINITIONS

A. Substitutions: Changes in products, materials, equipment, and methods of construction from those required by the Contract Documents.

1. Substitutions for Cause: Changes proposed by Contractor that are required due to changed Project conditions, such as unavailability of product, regulatory changes, or unavailability of required warranty terms.
2. Substitutions for Convenience: Changes proposed by Contractor or Owner that are not required to meet other Project requirements but may offer advantage to Contractor or Owner.

1.3 ACTION SUBMITTALS

A. Substitution Requests: Submit documentation identifying product or fabrication or installation method to be replaced. Include Specification Section number and title and Drawing numbers and titles.

1. Substitution Request Form: Use form acceptable to Architect.
2. Documentation: Show compliance with requirements for substitutions and the following, as applicable:

a. Statement indicating why specified product or fabrication or installation method cannot be provided, if applicable.
b. Coordination of information, including a list of changes or revisions 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. Detailed comparison of significant qualities of proposed substitutions with those of the Work specified. Include annotated copy of applicable Specification Section. Significant qualities may include attributes, such as performance, weight, size, durability, visual effect, sustainable design characteristics, warranties, and specific features and requirements indicated. Indicate deviations, if any, from the Work specified.
d. Product Data, including drawings and descriptions of products and fabrication and installation procedures.
e. Samples, where applicable or requested.
f. Certificates and qualification data, where applicable or requested.
g. List of similar installations for completed projects, with project names and addresses as well as names and addresses of architects and owners.
h. Material test reports from a qualified testing agency, indicating and interpreting test results for compliance with requirements indicated.
i. Research reports evidencing compliance with building code in effect for Project, from ICC-ES.
j. Detailed comparison of Contractor's construction schedule using proposed substitutions with products specified for the Work, including effect on the overall Contract Time. If specified product or method of construction cannot be provided within the Contract Time, include letter from manufacturer, on manufacturer's letterhead, stating date of receipt of purchase order, lack of availability, or delays in delivery.

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k. Cost information, including a proposal of change, if any, in the Contract Sum.
l. Contractor's certification that proposed substitution complies with requirements in the Contract Documents, except as indicated in substitution request, is compatible with related materials and is appropriate for applications indicated.
m. 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.

3. Architect's Action: If necessary, Architect will request additional information or documentation for evaluation within seven days of receipt of a request for substitution. Architect will notify Contractor of acceptance or rejection of proposed substitution within 15 days of receipt of request, or seven days of receipt of additional information or documentation, whichever is later.

a. Forms of Acceptance: Change Order, Construction Change Directive, or Architect's Supplemental Instructions for minor changes in the Work.
b. Use product specified if Architect does not issue a decision on use of a proposed substitution within time allocated.

1.4 QUALITY ASSURANCE

A. Compatibility of Substitutions: Investigate and document compatibility of proposed substitution with related products and materials. Engage a qualified testing agency to perform compatibility tests recommended by manufacturers.

1.5 PROCEDURES

A. Coordination: Revise or adjust affected work as necessary to integrate work of the approved substitutions.

1.6 SUBSTITUTIONS

A. Substitutions for Cause: Submit requests for substitution immediately on discovery of need for change, but not later than 15 days prior to time required for preparation and review of related submittals.

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

a. Requested substitution is consistent with the Contract Documents and will produce indicated results.
b. Substitution request is fully documented and properly submitted.
c. Requested substitution will not adversely affect Contractor's construction schedule.
d. Requested substitution has received necessary approvals from authorities having jurisdiction.
e. Requested substitution is compatible with other portions of the Work.
f. Requested substitution has been coordinated with other portions of the Work.
g. Requested substitution provides specified warranty.
h. If requested substitution involves more than one contractor, requested substitution has been coordinated with other portions of the Work, is uniform and consistent, is compatible with other products, and is acceptable to all contractors involved.

B. Substitutions for Convenience:

1. Architect will consider requests for substitution if received within 60 days after the Notice of Award. Requests received after that time may be considered or rejected at discretion of Architect.

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

1) Requested substitution offers Owner a substantial advantage in cost, time,

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energy conservation, or other considerations, after deducting additional responsibilities Owner must assume. Owner's additional responsibilities may include compensation to Architect for redesign and evaluation services, increased cost of other construction by Owner, and similar considerations.

2) Requested substitution does not require extensive revisions to the Contract Documents.
3) Requested substitution is consistent with the Contract Documents and will produce indicated results.
4) Substitution request is fully documented and properly submitted.
5) Requested substitution will not adversely affect Contractor's construction schedule.
6) Requested substitution has received necessary approvals from authorities having jurisdiction.
7) Requested substitution is compatible with other portions of the Work.
8) Requested substitution has been coordinated with other portions of the Work.
9) Requested substitution provides specified warranty.
10) If requested substitution involves more than one contractor, requested substitution has been coordinated with other portions of the Work, is uniform and consistent, is compatible with other products, and is acceptable to all contractors involved.

PART 2 - PRODUCTS (Not Used)
PART 3 - EXECUTION (Not Used)

END OF SECTION 01 25 00

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SECTION 01 26 00 - CONTRACT MODIFICATION PROCEDURES

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes administrative and procedural requirements for handling and processing Contract modifications.

B. Related Requirements:

1. Section 012500 "Substitution Procedures" for administrative procedures for handling requests for substitutions made after the Contract award.

1.2 MINOR CHANGES IN THE WORK

A. Architect will issue supplemental instructions authorizing minor changes in the Work, not involving adjustment to the Contract Sum or the Contract Time, on form included in Project Manual .

1.3 PROPOSAL REQUESTS

A. Owner-Initiated Proposal Requests: Architect will issue a detailed description of proposed changes in the Work that may require adjustment to the Contract Sum or the Contract Time. If necessary, the description will include supplemental or revised Drawings and Specifications.

1. Work Change Proposal Requests issued by Architect are not instructions either to stop work in progress or to execute the proposed change.
2. Within 20 days, when not otherwise specified, after receipt of Proposal Request, submit a quotation estimating cost adjustments to the Contract Sum and the Contract Time necessary to execute the change.

   a. Include a list of quantities of products required or eliminated and unit costs, with total amount of purchases and credits to be made. If requested, furnish survey data to substantiate quantities.
   b. Indicate applicable taxes, delivery charges, equipment rental, and amounts of trade discounts.
   c. Include costs of labor and supervision directly attributable to the change.
   d. Include an updated Contractor's construction schedule that indicates the effect of the change, including, but not limited to, changes in activity duration, start and finish times, and activity relationship. Use available total float before requesting an extension of the Contract Time.
   e. Quotation Form: Use forms acceptable to Architect .

B. Contractor-Initiated Proposals: If latent or changed conditions require modifications to the Contract, Contractor may initiate a claim by submitting a request for a change to Architect.

1. Include a statement outlining reasons for the change and the effect of the change on the Work. Provide a complete description of the proposed change. Indicate the effect of the proposed change on the Contract Sum and the Contract Time.
2. Include a list of quantities of products required or eliminated and unit costs, with total amount of purchases and credits to be made. If requested, furnish survey data to substantiate quantities.
3. Indicate applicable taxes, delivery charges, equipment rental, and amounts of trade discounts.
4. Include costs of labor and supervision directly attributable to the change.
5. Include an updated Contractor's construction schedule that indicates the effect of the change, including, but not limited to, changes in activity duration, start and finish times, and activity relationship. Use available total float before requesting an extension of the Contract Time.
6. Comply with requirements in Section 012500 "Substitution Procedures" if the proposed change requires substitution of one product or system for product or system specified.
7. Proposal Request Form: Use form acceptable to Architect .

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1.4 ADMINISTRATIVE CHANGE ORDERS

A. Allowance Adjustment: See Section 012100 "Allowances" for administrative procedures for preparation of Change Order Proposal for adjusting the Contract Sum to reflect actual costs of allowances.

B. Unit-Price Adjustment: See Section 012200 "Unit Prices" for administrative procedures for preparation of Change Order Proposal for adjusting the Contract Sum to reflect measured scope of unit-price work.

1.5 CHANGE ORDER PROCEDURES

A. On Owner's approval of a Work Change Proposal Request, Construction Manager will issue a Change Order for signatures of Owner and Contractor on form included in Project Manual .

1.6 CONSTRUCTION CHANGE DIRECTIVE

A. Construction Change Directive: Architect may issue a Construction Change Directive on form included in Project Manual . Construction Change Directive instructs Contractor to proceed with a change in the Work, for subsequent inclusion in a Change Order.

1. Construction Change Directive contains a complete description of change in the Work. It also designates method to be followed to determine change in the Contract Sum or the Contract Time.

B. Documentation: Maintain detailed records on a time and material basis of work required by the Construction Change Directive.

1. After completion of change, submit an itemized account and supporting data necessary to substantiate cost and time adjustments to the Contract.

PART 2 - PRODUCTS (Not Used)
PART 3 - EXECUTION (Not Used)

END OF SECTION 01 26 00

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SECTION 01 29 00 - PAYMENT PROCEDURES

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes administrative and procedural requirements necessary to prepare and process Applications for Payment.

B. Related Requirements:

1. Section 012100 "Allowances" for procedural requirements governing the handling and processing of allowances.
2. Section 012600 "Contract Modification Procedures" for administrative procedures for handling changes to the Contract.
3. Section 013200 "Construction Progress Documentation" for administrative requirements governing the preparation and submittal of the Contractor's construction schedule.

1.2 DEFINITIONS

A. Schedule of Values: A statement furnished by Contractor allocating portions of the Contract Sum to various portions of the Work and used as the basis for reviewing Contractor's Applications for Payment.

1.3 SCHEDULE OF VALUES

A. Coordination: Coordinate preparation of the schedule of values with preparation of Contractor's construction schedule. Cost-loaded Critical Path Method Schedule may serve to satisfy requirements for the schedule of values.

1. Coordinate line items in the schedule of values with items required to be indicated as separate activities in Contractor's construction schedule.
2. Submit the schedule of values to Architect at earliest possible date, but no later than seven days before the date scheduled for submittal of initial Applications for Payment.
3. Subschedules for Phased Work: Where the Work is separated into phases requiring separately phased payments, provide subschedules showing values coordinated with each phase of payment.
4. Subschedules for Separate Elements of Work: Where the Contractor's construction schedule defines separate elements of the Work, provide subschedules showing values coordinated with each element.
5. Subschedules for Separate Design Contracts: Where the Owner has retained design professionals under separate contracts who will each provide certification of payment requests, provide subschedules showing values coordinated with the scope of each design services contract, as described in Section 011000 "Summary."

B. Format and Content: Use Project Manual table of contents as a guide to establish line items for the schedule of values. Provide at least one line item for each Specification Section.

1. Identification: Include the following Project identification on the schedule of values:

   a. Project name and location.
   b. Owner's name.
   c. Owner's Project number.
   d. Name of Architect.
   e. Architect's Project number.
   f. Contractor's name and address.
   g. Date of submittal.

2. Arrange schedule of values consistent with format of AIA Document G703 .
3. Arrange the schedule of values in tabular form, with separate columns to indicate the following

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for each item listed:

a. Related Specification Section or division.
b. Description of the Work.
c. Name of subcontractor.
d. Name of manufacturer or fabricator.
e. Name of supplier.
f. Change Orders (numbers) that affect value.
g. Dollar value of the following, as a percentage of the Contract Sum to nearest one-hundredth percent, adjusted to total 100 percent. Round dollar amounts to whole dollars, with total equal to Contract Sum.

1) Labor.
2) Materials.
3) Equipment.

4. Provide a breakdown of the Contract Sum in enough detail to facilitate continued evaluation of Applications for Payment and progress reports. Provide multiple line items for principal subcontract amounts in excess of five percent of the Contract Sum.
5. Provide a separate line item in the schedule of values for each part of the Work where Applications for Payment may include materials or equipment purchased or fabricated and stored, but not yet installed.

a. Differentiate between items stored on-site and items stored off-site.

6. Allowances: Provide a separate line item in the schedule of values for each allowance. Show line-item value of unit-cost allowances, as a product of the unit cost, multiplied by measured quantity. Use information indicated in the Contract Documents to determine quantities.
7. Purchase Contracts: Provide a separate line item in the schedule of values for each Purchase contract. Show line-item value of Purchase contract. Indicate Owner payments or deposits, if any, and balance to be paid by Contractor.
8. Overhead Costs, Proportional Distribution: Include total cost and proportionate share of general overhead and profit for each line item.
9. Overhead Costs, Separate Line Items: Show cost of temporary facilities and other major cost items that are not direct cost of actual work-in-place as separate line items.
10. Temporary Facilities: Show cost of temporary facilities and other major cost items that are not direct cost of actual work-in-place as separate line items.
11. Closeout Costs. Include separate line items under Contractor and principal subcontracts for Project closeout requirements in an amount totaling five percent of the Contract Sum and subcontract amount.
12. Schedule of Values Revisions: Revise the schedule of values when Change Orders or Construction Change Directives result in a change in the Contract Sum. Include at least one separate line item for each Change Order and Construction Change Directive.

1.4 APPLICATIONS FOR PAYMENT

A. Each Application for Payment following the initial Application for Payment shall be consistent with previous applications and payments, as certified by Architect and paid for by Owner.

B. Payment Application Times: The date for each progress payment is indicated in the Owner/Contractor Agreement. The period of construction work covered by each Application for Payment is the period indicated in the Agreement.

C. Application for Payment Forms: Use AIA Document G702 and AIA Document G703 as form for Applications for Payment.

1. Other Application for Payment forms proposed by the Contractor may be acceptable to Architect and Owner. Submit forms for approval with initial submittal of schedule of values.

D. Application Preparation: Complete every entry on form. Notarize and execute by a person authorized to sign legal documents on behalf of Contractor. Architect will return incomplete applications without action.

1. Entries shall match data on the schedule of values and Contractor's construction schedule. Use

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updated schedules if revisions were made.

2. Include amounts for work completed following previous Application for Payment, whether or not payment has been received. Include only amounts for work completed at time of Application for Payment.
3. Include amounts of Change Orders and Construction Change Directives issued before last day of construction period covered by application.
4. Indicate separate amounts for work being carried out under Owner-requested project acceleration.

E. Stored Materials: Include in Application for Payment amounts applied for materials or equipment purchased or fabricated and stored, but not yet installed. Differentiate between items stored on-site and items stored off-site.

1. Provide certificate of insurance, evidence of transfer of title to Owner, and consent of surety to payment for stored materials.
2. Provide supporting documentation that verifies amount requested, such as paid invoices. Match amount requested with amounts indicated on documentation; do not include overhead and profit on stored materials.
3. Provide summary documentation for stored materials indicating the following:

   a. Value of materials previously stored and remaining stored as of date of previous Applications for Payment.
   b. Value of previously stored materials put in place after date of previous Application for Payment and on or before date of current Application for Payment.
   c. Value of materials stored since date of previous Application for Payment and remaining stored as of date of current Application for Payment.

F. Transmittal: Submit 1 signed and notarized original copies of each Application for Payment to Architect by a method ensuring receipt within 24 hours. One copy shall include waivers of lien and similar attachments if required.

1. Transmit each copy with a transmittal form listing attachments and recording appropriate information about application.

G. Waivers of Mechanic's Lien: With each Application for Payment, submit waivers of mechanic's lien from entities lawfully entitled to file a mechanic's lien arising out of the Contract and related to the Work covered by the payment.

1. Submit partial waivers on each item for amount requested in previous application, after deduction for retainage, on each item.
2. When an application shows completion of an item, submit conditional final or full waivers.
3. Owner reserves the right to designate which entities involved in the Work must submit waivers.
4. Submit final Application for Payment with or preceded by conditional final waivers from every entity involved with performance of the Work covered by the application who is lawfully entitled to a lien.
5. Waiver Forms: Submit executed waivers of lien on forms acceptable to Owner.

H. Initial Application for Payment: Administrative actions and submittals that must precede or coincide with submittal of first Application for Payment include the following:

1. List of subcontractors.
2. Schedule of values.
3. Contractor's construction schedule (preliminary if not final).
4. Combined Contractor's construction schedule (preliminary if not final) incorporating Work of multiple contracts, with indication of acceptance of schedule by each Contractor.
5. Products list (preliminary if not final).
6. Sustainable design action plans, including preliminary project materials cost data.
7. Schedule of unit prices.
8. Submittal schedule (preliminary if not final).
9. List of Contractor's staff assignments.
10. List of Contractor's principal consultants.
11. Copies of building permits.
12. Copies of authorizations and licenses from authorities having jurisdiction for performance of the Work.

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13. Initial progress report.
14. Report of preconstruction conference.
15. Certificates of insurance and insurance policies.
16. Performance and payment bonds.
17. Data needed to acquire Owner's insurance.

I. Application for Payment at Substantial Completion: After Architect issues the Certificate of Substantial Completion, submit an Application for Payment showing 100 percent completion for portion of the Work claimed as substantially complete.

1. Include documentation supporting claim that the Work is substantially complete and a statement showing an accounting of changes to the Contract Sum.

   a. Complete administrative actions, submittals, and Work preceding this application, as described in Section 017700 "Closeout Procedures."

2. This application shall reflect Certificate(s) of Substantial Completion issued previously for Owner occupancy of designated portions of the Work.

J. Final Payment Application: After completing Project closeout requirements, submit final Application for Payment with releases and supporting documentation not previously submitted and accepted, including, but not limited, to the following:

1. Evidence of completion of Project closeout requirements.
2. Certification of completion of final punch list items.
3. Insurance certificates for products and completed operations where required and proof that taxes, fees, and similar obligations were paid.
4. Updated final statement, accounting for final changes to the Contract Sum.
5. AIA Document G706.
6. AIA Document G706A.
7. AIA Document G707.
8. Evidence that claims have been settled.
9. Final meter readings for utilities, a measured record of stored fuel, and similar data as of date of Substantial Completion or when Owner took possession of and assumed responsibility for corresponding elements of the Work.
10. Final liquidated damages settlement statement.
11. Proof that taxes, fees, and similar obligations are paid.
12. Waivers and releases.

PART 2 - PRODUCTS (Not Used)
PART 3 - EXECUTION (Not Used)

END OF SECTION 01 29 00

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SECTION 01 31 00 - PROJECT MANAGEMENT AND COORDINATION

PART 1 - GENERAL

1.1 SUMMARY

A. The Work of this Section includes administrative provisions for coordinating construction operations on Project, including, but not limited to, the following:

1. General coordination procedures.
2. Coordination drawings.
3. RFIs.
4. Digital project management procedures.
5. Web-based Project management software package.
6. Project meetings.

B. Each contractor shall participate in coordination requirements. Certain areas of responsibility are assigned to a specific contractor.

C. Related Requirements:

1. Section 013200 "Construction Progress Documentation" for preparing and submitting Contractor's construction schedule.
2. Section 017300 "Execution" for procedures for coordinating general installation and field-engineering services, including establishment of benchmarks and control points.
3. Section 017700 "Closeout Procedures" for coordinating closeout of the Contract.

1.2 DEFINITIONS

A. BIM: Building Information Modeling.

B. RFI: Request for Information. Request from Owner, Architect, or Contractor seeking information required by or clarifications of the Contract Documents.

1.3 INFORMATIONAL SUBMITTALS

A. Subcontract List: Prepare a written summary identifying individuals or firms proposed for each portion of the Work, including those who are to furnish products or equipment fabricated to a special design. Include the following information in tabular form:

1. Name, address, telephone number, and email address of entity performing subcontract or supplying products.
2. Number and title of related Specification Section(s) covered by subcontract.
3. Drawing number and detail references, as appropriate, covered by subcontract.

B. Key Personnel Names: Within 15 days of starting construction operations, submit a list of key personnel assignments, including superintendent and other personnel in attendance at Project site. Identify individuals and their duties and responsibilities; list addresses, cellular telephone numbers, and e-mail addresses. Provide names, addresses, and telephone numbers of individuals assigned as alternates in the absence of individuals assigned to Project.

1. Post copies of list in Project meeting room, in temporary field office, in web-based Project software directory, and in prominent location in each built facility. Keep list current at all times.

1.4 GENERAL COORDINATION PROCEDURES

A. Coordination: Coordinate construction operations included in different Sections of the Specifications to ensure efficient and orderly installation of each part of the Work. Coordinate construction operations included in different Sections that depend on each other for proper installation, connection, and operation.

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1. Schedule construction operations in sequence required to obtain the best results, where installation of one part of the Work depends on installation of other components, before or after its own installation.
2. Coordinate installation of different components to ensure maximum performance and accessibility for required maintenance, service, and repair.
3. Make adequate provisions to accommodate items scheduled for later installation.

B. Prepare memoranda for distribution to each party involved, outlining special procedures required for coordination. Include such items as required notices, reports, and list of attendees at meetings.

1. Prepare similar memoranda for Owner and separate contractors if coordination of their Work is required.

C. Administrative Procedures: Coordinate scheduling and timing of required administrative procedures with other construction activities to avoid conflicts and to ensure orderly progress of the Work. Such administrative activities include, but are not limited to, the following:

1. Preparation of Contractor's construction schedule.
2. Preparation of the schedule of values.
3. Installation and removal of temporary facilities and controls.
4. Delivery and processing of submittals.
5. Progress meetings.
6. Preinstallation conferences.
7. Project closeout activities.
8. Startup and adjustment of systems.

1.5 COORDINATION DRAWINGS

A. Coordination Drawings, General: Prepare coordination drawings according to requirements in individual Sections, and additionally where installation is not completely indicated on Shop Drawings, where limited space availability necessitates coordination, or if coordination is required to facilitate integration of products and materials fabricated or installed by more than one entity.

1. Content: Project-specific information, drawn accurately to a scale large enough to indicate and resolve conflicts. Do not base coordination drawings on standard printed data. Include the following information, as applicable:

a. Use applicable Drawings as a basis for preparation of coordination drawings. Prepare sections, elevations, and details as needed to describe relationship of various systems and components.
b. Coordinate the addition of trade-specific information to coordination drawings in a sequence that best provides for coordination of the information and resolution of conflicts between installed components before submitting for review.
c. Indicate functional and spatial relationships of components of architectural, structural, civil, mechanical, and electrical systems.
d. Indicate space requirements for routine maintenance and for anticipated replacement of components during the life of the installation.
e. Show location and size of access doors required for access to concealed dampers, valves, and other controls.
f. Indicate required installation sequences.
g. Indicate dimensions shown on Drawings. Specifically note dimensions that appear to be in conflict with submitted equipment and minimum clearance requirements. Provide alternative sketches to Architect indicating proposed resolution of such conflicts. Minor dimension changes and difficult installations will not be considered changes to the Contract.

B. Coordination Drawing Organization: Organize coordination drawings as follows:

1. Floor Plans and Reflected Ceiling Plans: Show architectural and structural elements, and mechanical, plumbing, fire-protection, fire-alarm, and electrical Work. Show locations of visible ceiling-mounted devices relative to acoustical ceiling grid. Supplement plan drawings with section drawings where required to adequately represent the Work.
2. Plenum Space: Indicate subframing for support of ceiling , raised access floor, and wall

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systems, mechanical and electrical equipment, and related Work. Locate components within plenums to accommodate layout of light fixtures and other components indicated on Drawings. Indicate areas of conflict between light fixtures and other components.

3. Mechanical Rooms: Provide coordination drawings for mechanical rooms, showing plans and elevations of mechanical, plumbing, fire-protection, fire-alarm, and electrical equipment.
4. Structural Penetrations: Indicate penetrations and openings required for all disciplines.
5. Slab Edge and Embedded Items: Indicate slab edge locations and sizes and locations of embedded items for metal fabrications, sleeves, anchor bolts, bearing plates, angles, door floor closers, slab depressions for floor finishes, curbs and housekeeping pads, and similar items.
6. Mechanical and Plumbing Work: Show the following:

    a. Sizes and bottom elevations of ductwork, piping, and conduit runs, including insulation, bracing, flanges, and support systems.
    b. Dimensions of major components, such as dampers, valves, diffusers, access doors, cleanouts and electrical distribution equipment.
    c. Fire-rated enclosures around ductwork.

7. Electrical Work: Show the following:

    a. Runs of vertical and horizontal conduit **1-1/4 inches** in diameter and larger.
    b. Light fixture, exit light, emergency battery pack, smoke detector, and other fire-alarm locations.
    c. Panel board, switchboard, switchgear, transformer, busway, generator, and motor-control center locations.
    d. Location of pull boxes and junction boxes, dimensioned from column center lines.

8. Fire-Protection System: Show the following:

    a. Locations of standpipes, mains piping, branch lines, pipe drops, and sprinkler heads.

9. Review: Architect will review coordination drawings to confirm that, in general, the Work is being coordinated, but not for the details of the coordination, which are Contractor's responsibility. If Architect determines that coordination drawings are not being prepared in sufficient scope or detail, or are otherwise deficient, Architect will so inform Contractor, who shall make suitable modifications and resubmit.
10. Coordination Drawing Prints: Prepare coordination drawing prints according to requirements in Section 013300 "Submittal Procedures."

C. Coordination Digital Data Files: Prepare coordination digital data files according to the following requirements:

1. File Submittal Format: Submit or post coordination drawing files using PDF format .
2. Architect will furnish Contractor one set of digital data files of Drawings for use in preparing coordination digital data files.

    a. Architect makes no representations as to the accuracy or completeness of digital data files as they relate to Drawings.
    b. Digital Data Software Program: Drawings are available in Revit and/or AutoCAD.
    c. Contractor shall execute a data licensing agreement in the form of Agreement included in this Project Manual .

1.6 REQUEST FOR INFORMATION (RFI)

A. General: Immediately on discovery of the need for additional information, clarification, or interpretation of the Contract Documents, Contractor shall prepare and submit an RFI in the form specified.

1. Architect will return without response those RFIs submitted to Architect by other entities controlled by Contractor.
2. Coordinate and submit RFIs in a prompt manner to avoid delays in Contractor's work or work of subcontractors.

B. Content of the RFI: Include a detailed, legible description of item needing information or interpretation and the following:

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1. Project name.
2. Owner name.
3. Owner's Project number.
4. Name of Architect .
5. Architect's Project number.
6. Date.
7. Name of Contractor.
8. RFI number, numbered sequentially.
9. RFI subject.
10. Specification Section number and title and related paragraphs, as appropriate.
11. Drawing number and detail references, as appropriate.
12. Field dimensions and conditions, as appropriate.
13. Contractor's suggested resolution. If Contractor's suggested resolution impacts the Contract Time or the Contract Sum, Contractor shall state impact in the RFI.
14. Contractor's signature.
15. Attachments: Include sketches, descriptions, measurements, photos, Product Data, Shop Drawings, coordination drawings, and other information necessary to fully describe items needing interpretation.

    a. Include dimensions, thicknesses, structural grid references, and details of affected materials, assemblies, and attachments on attached sketches.

C. RFI Forms: Software-generated form with substantially the same content as indicated above, acceptable to Architect .

1. Attachments shall be electronic files in PDF format.

D. Action: Architect will review each RFI, determine action required, and respond. Allow seven days for Architect's response for each RFI. RFIs received by Architect after 1:00 p.m. will be considered as received the following working day.

1. The following Contractor-generated RFIs will be returned without action:

    a. Requests for approval of submittals.
    b. Requests for approval of substitutions.
    c. Requests for approval of Contractor's means and methods.
    d. Requests for coordination information already indicated in the Contract Documents.
    e. Requests for adjustments in the Contract Time or the Contract Sum.
    f. Requests for interpretation of Architect's actions on submittals.
    g. Incomplete RFIs or inaccurately prepared RFIs.

2. Architect's action may include a request for additional information, in which case Architect's time for response will date from time of receipt by Architect of additional information.
3. Architect's action on RFIs that may result in a change to the Contract Time or the Contract Sum may be eligible for Contractor to submit Change Proposal according to Section 012600 "Contract Modification Procedures."

    a. If Contractor believes the RFI response warrants change in the Contract Time or the Contract Sum, notify Architect in writing within 5 days of receipt of the RFI response.

E. RFI Log: Prepare, maintain, and submit a tabular log of RFIs organized by the RFI number. Submit log weekly . Use software log that is part of web-based Project management software. Include the following:

1. Project name.
2. Name and address of Contractor.
3. Name and address of Architect .
4. RFI number, including RFIs that were returned without action or withdrawn.
5. RFI description.
6. Date the RFI was submitted.
7. Date Architect's response was received.
8. Identification of related Minor Change in the Work, Construction Change Directive, and Proposal Request, as appropriate.
9. Identification of related Field Order, Work Change Directive, and Proposal Request, as

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appropriate.

F. On receipt of Architect's action, update the RFI log and immediately distribute the RFI response to affected parties. Review response and notify Architect within [**seven**] days if Contractor disagrees with response.

1.7 DIGITAL PROJECT MANAGEMENT PROCEDURES

A. Use of Architect's Digital Data Files: Digital data files of Architect's BIM model CAD drawings will be provided by Architect for Contractor's use during construction.

1. Digital data files may be used by Contractor in preparing coordination drawings, Shop Drawings, and Project Record Drawings.
2. Architect makes no representations as to the accuracy or completeness of digital data files as they relate to Contract Drawings.
3. Digital Drawing Software Program: Contract Drawings are available in Revit and/or AutoCAD.
4. Contractor shall execute a data licensing agreement in the form of Agreement included in Project Manual .

   a. Subcontractors and other parties granted access by Contractor to Architect's digital data files shall execute a data licensing agreement in the form of Agreement included in this Project Manual .

B. Web-Based Project Management Software Package: Provide, administer, and use web-based Project management software package for purposes of hosting and managing Project communication and documentation until Final Completion.

1. Web-based Project management software includes, at a minimum, the following features:

   a. Compilation of Project data, including Contractor, subcontractors, Architect, Architect's consultants, Owner, and other entities involved in Project. Include names of individuals and contact information.
   b. Access control for each entity for each workflow process, to determine entity's digital rights to create, modify, view, and print documents.
   c. Document workflow planning, allowing customization of workflow between project entities.
   d. Creation, logging, tracking, and notification for Project communications required in other Specification Sections, including, but not limited to, RFIs, submittals, Minor Changes in the Work, Construction Change Directives, and Change Orders.
   e. Track status of each Project communication in real time, and log time and date when responses are provided.
   f. Procedures for handling PDFs or similar file formats, allowing markups by each entity. Provide security features to lock markups against changes once submitted.
   g. Processing and tracking of payment applications.
   h. Processing and tracking of contract modifications.
   i. Creating and distributing meeting minutes.
   j. Document management for Drawings, Specifications, and coordination drawings, including revision control.
   k. Management of construction progress photographs.
   l. Mobile device compatibility, including smartphones and tablets.

2. Provide up to seven Project management software user licenses for use of Owner , Architect, and Architect's consultants. Provide software training at Architect's office for web-based Project software users.
3. At completion of Project, provide digital archive in format that is readable by common desktop software applications in format acceptable to Architect. Provide data in locked format to prevent further changes.
4. 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. Autodesk, Inc.
   b. Corecon Technologies, Inc.
   c. Deltek Inc.

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d. Meridian Systems, Inc.
e. Newforma, Inc.
f. Procore Technologies, Inc.
g. Viewpoint, Inc.; a Trimble Company.

C. PDF Document Preparation: Where PDFs are required to be submitted to Architect, prepare as follows:

1. Assemble complete submittal package into a single indexed file, incorporating submittal requirements of a single Specification Section and transmittal form with links enabling navigation to each item.
2. Name file with submittal number or other unique identifier, including revision identifier.
3. Certifications: Where digitally submitted certificates and certifications are required, provide a digital signature with digital certificate on where indicated.

1.8 PROJECT MEETINGS

A. General: Schedule and conduct meetings and conferences at Project site unless otherwise indicated.

1. Attendees: Inform participants and others involved, and individuals whose presence is required, of date and time of each meeting. Notify Owner and Architect of scheduled meeting dates and times a minimum of seven days prior to meeting.
2. Agenda: Prepare the meeting agenda. Distribute the agenda to all invited attendees.
3. Minutes: Entity responsible for conducting meeting will record significant discussions and agreements achieved. Distribute the meeting minutes to everyone concerned, including Owner and Architect, within three days of the meeting.

B. Preconstruction Conference: Schedule and conduct a preconstruction conference before starting construction, at a time convenient to Owner and Architect, but no later than 15 days after execution of the Agreement.

1. Attendees: Authorized representatives of Owner Architect, and their consultants; Contractor and its superintendent; major subcontractors; suppliers; and other concerned parties shall attend the conference. Participants at the conference shall be familiar with Project and authorized to conclude matters relating to the Work.
2. Agenda: Discuss items of significance that could affect progress, including the following:

a. Responsibilities and personnel assignments.
b. Tentative construction schedule.
c. Phasing.
d. Critical work sequencing and long lead items.
e. Designation of key personnel and their duties.
f. Lines of communications.
g. Use of web-based Project software.
h. Procedures for processing field decisions and Change Orders.
i. Procedures for RFIs.
j. Procedures for testing and inspecting.
k. Procedures for processing Applications for Payment.
l. Distribution of the Contract Documents.
m. Submittal procedures.
n. Sustainable design requirements.
o. Preparation of Record Documents.
p. Use of the premises .
q. Work restrictions.
r. Working hours.
s. Owner's occupancy requirements.
t. Responsibility for temporary facilities and controls.
u. Procedures for moisture and mold control.
v. Procedures for disruptions and shutdowns.
w. Construction waste management and recycling.
x. Parking availability.
y. Office, work, and storage areas.
z. Equipment deliveries and priorities.

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aa. First aid.
bb. Security.
cc. Progress cleaning.

3. Minutes: Entity responsible for conducting meeting will record and distribute meeting minutes.

C. Preinstallation Conferences: Conduct a preinstallation conference at Project site before each construction activity when required by other Sections and when required for coordination with other construction.

1. Attendees: Installer and representatives of manufacturers and fabricators involved in or affected by the installation and its coordination or integration with other materials and installations that have preceded or will follow, shall attend the meeting. Advise Architect of scheduled meeting dates.
2. Agenda: Review progress of other construction activities and preparations for the particular activity under consideration, including requirements for the following:

a. Contract Documents.
b. Options.
c. Related RFIs.
d. Related Change Orders.
e. Purchases.
f. Deliveries.
g. Submittals.
h. Sustainable design requirements.
i. Review of mockups.
j. Possible conflicts.
k. Compatibility requirements.
l. Time schedules.
m. Weather limitations.
n. Manufacturer's written instructions.
o. Warranty requirements.
p. Compatibility of materials.
q. Acceptability of substrates.
r. Temporary facilities and controls.
s. Space and access limitations.
t. Regulations of authorities having jurisdiction.
u. Testing and inspecting requirements.
v. Installation procedures.
w. Coordination with other work.
x. Required performance results.
y. Protection of adjacent work.
z. Protection of construction and personnel.

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

D. Progress Meetings: Conduct progress meetings at regular intervals.

1. Coordinate dates of meetings with preparation of payment requests.
2. Attendees: In addition to representatives of Owner and 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. All participants at the meeting shall be familiar with Project and authorized to conclude matters relating to the Work.
3. Agenda: Review and correct or approve minutes of previous progress meeting. Review other items of significance that could affect progress. Include topics for discussion as appropriate to status of Project.

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a. Contractor's Construction Schedule: Review progress since the last meeting. Determine whether each activity is on time, ahead of schedule, or behind schedule, in relation to Contractor's construction schedule. Determine how construction behind schedule will be expedited; secure commitments from parties involved to do so. Discuss whether schedule revisions are required to ensure that current and subsequent activities will be completed within the Contract Time.

1) Review schedule for next period.

b. Review present and future needs of each entity present, including the following:

1) Interface requirements.
2) Sequence of operations.
3) Resolution of BIM component conflicts.
4) Status of submittals.
5) Status of sustainable design documentation.
6) Deliveries.
7) Off-site fabrication.
8) Access.
9) Site use.
10) Temporary facilities and controls.
11) Progress cleaning.
12) Quality and work standards.
13) Status of correction of deficient items.
14) Field observations.
15) Status of RFIs.
16) Status of Proposal Requests.
17) Pending changes.
18) Status of Change Orders.
19) Pending claims and disputes.
20) Documentation of information for payment requests.

4. Minutes: Entity responsible for conducting the meeting will record and distribute the meeting minutes to each party present and to parties requiring information.

a. Schedule Updating: Revise Contractor's construction schedule after each progress meeting, where revisions to the schedule have been made or recognized. Issue revised schedule concurrently with the report of each meeting.

E. Coordination Meetings: Conduct Project coordination meetings at regular intervals. Project coordination meetings are in addition to specific meetings held for other purposes, such as progress meetings and preinstallation conferences.

1. Attendees: In addition to representatives of Owner and 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. All participants at the meetings shall be familiar with Project and authorized to conclude matters relating to the Work.
2. Agenda: Review and correct or approve minutes of the previous coordination meeting. Review other items of significance that could affect progress. Include topics for discussion as appropriate to status of Project.

a. Combined Contractor's Construction Schedule: Review progress since the last coordination meeting. Determine whether each contract is on time, ahead of schedule, or behind schedule, in relation to combined Contractor's construction schedule. Determine how construction behind schedule will be expedited; secure commitments from parties involved to do so. Discuss whether schedule revisions are required to ensure that current and subsequent activities will be completed within the Contract Time.
b. Schedule Updating: Revise combined Contractor's construction schedule after each coordination meeting, where revisions to the schedule have been made or recognized. Issue revised schedule concurrently with report of each meeting.
c. Review present and future needs of each contractor present, including the following:

1) Interface requirements.

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2) Sequence of operations.
3) Resolution of BIM component conflicts.
4) Status of submittals.
5) Deliveries.
6) Off-site fabrication.
7) Access.
8) Site use.
9) Temporary facilities and controls.
10) Work hours.
11) Hazards and risks.
12) Progress cleaning.
13) Quality and work standards.
14) Status of RFIs.
15) Proposal Requests.
16) Change Orders.
17) Pending changes.

3. Reporting: Record meeting results and distribute copies to everyone in attendance and to others affected by decisions or actions resulting from each meeting.

F. Project Closeout Conference: Schedule and conduct a project closeout conference, at a time convenient to Owner and Architect, but no later than 90 days prior to the scheduled date of Substantial Completion.

1. Conduct the conference to review requirements and responsibilities related to Project closeout.
2. Attendees: Authorized representatives of Owner, Architect, and their consultants; Contractor and its superintendent; major subcontractors; suppliers; and other concerned parties shall attend the meeting. Participants at the meeting shall be familiar with Project and authorized to conclude matters relating to the Work.
3. Agenda: Discuss items of significance that could affect or delay Project closeout, including the following:

a. Preparation of Record Documents.
b. Procedures required prior to inspection for Substantial Completion and for final inspection for acceptance.
c. Procedures for completing and archiving web-based Project software site data files.
d. Submittal of written warranties.
e. Requirements for completing sustainable design documentation.
f. Requirements for preparing operations and maintenance data.
g. Requirements for delivery of material samples, attic stock, and spare parts.
h. Requirements for demonstration and training.
i. Preparation of Contractor's punch list.
j. Procedures for processing Applications for Payment at Substantial Completion and for final payment.
k. Submittal procedures.
l. Coordination of separate contracts.
m. Owner's partial occupancy requirements.
n. Installation of Owner's furniture, fixtures, and equipment.
o. Responsibility for removing temporary facilities and controls.

4. Minutes: Entity conducting meeting will record and distribute meeting minutes.

PART 2 - PRODUCTS (Not Used)
PART 3 - EXECUTION (Not Used)

END OF SECTION 01 31 00

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SECTION 01 32 00 - CONSTRUCTION PROGRESS DOCUMENTATION

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes administrative and procedural requirements for documenting the progress of construction during performance of the Work, including the following:

1. Startup construction schedule.
2. Contractor's Construction Schedule.
3. Construction schedule updating reports.
4. Daily construction reports.
5. Material location reports.
6. Site condition reports.
7. Unusual event reports.

B. Related Requirements:

1. Section 012900 "Payment Procedures" for schedule of values and requirements for use of cost-loaded schedule for Applications for Payment.
2. Section 014000 "Quality Requirements" for schedule of tests and inspections.

1.2 DEFINITIONS

A. Activity: A discrete part of a project that can be identified for planning, scheduling, monitoring, and controlling the construction Project. Activities included in a construction schedule consume time and resources.

1. Critical Activity: An activity on the critical path that must start and finish on the planned early start and finish times.
2. Predecessor Activity: An activity that precedes another activity in the network.
3. Successor Activity: An activity that follows another activity in the network.

B. Cost Loading: The allocation of the schedule of values for completing an activity as scheduled. The sum of costs for all activities must equal the total Contract Sum.

C. CPM: Critical path method, which is a method of planning and scheduling a construction project where activities are arranged based on activity relationships. Network calculations determine the critical path of Project and when activities can be performed.

D. Critical Path: The longest connected chain of interdependent activities through the network schedule that establishes the minimum overall Project duration and contains no float.

E. Event: The starting or ending point of an activity.

F. Float: The measure of leeway in starting and completing an activity.

1. Float time is not for the exclusive use or benefit of either Owner or Contractor, but is a jointly owned, expiring Project resource available to both parties as needed to meet schedule milestones and Contract completion date .
2. Free float is the amount of time an activity can be delayed without adversely affecting the early start of the successor activity.
3. Total float is the measure of leeway in starting or completing an activity without adversely affecting the planned Project completion date.

G. Resource Loading: The allocation of labor and equipment necessary for completing an activity as scheduled.

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1.3 INFORMATIONAL SUBMITTALS

A. Format for Submittals: Submit required submittals in the following format:

1. Working electronic copy of schedule file.
2. PDF file.

B. Startup construction schedule.

1. Submittal of cost-loaded startup construction schedule will not constitute approval of schedule of values for cost-loaded activities.

C. Startup Network Diagram: Of size required to display entire network for entire construction period. Show logic ties for activities.

D. Contractor's Construction Schedule: Initial schedule, of size required to display entire schedule for entire construction period.

1. Submit a working digital copy of schedule, using software indicated, and labeled to comply with requirements for submittals.

E. CPM Reports: Concurrent with CPM schedule, submit each of the following reports. Format for each activity in reports to contain activity number, activity description, cost and resource loading, original duration, remaining duration, early start date, early finish date, late start date, late finish date, and total float in calendar days.

1. Activity Report: List of activities sorted by activity number and then early start date, or actual start date if known.
2. Logic Report: List of preceding and succeeding activities for each activity, sorted in ascending order by activity number and then by early start date, or actual start date if known.
3. Total Float Report: List of activities sorted in ascending order of total float.
4. Earnings Report: Compilation of Contractor's total earnings from commencement of the Work until most recent Application for Payment.

F. Construction Schedule Updating Reports: Submit with Applications for Payment.

G. Daily Construction Reports: Submit at monthly intervals.

H. Material Location Reports: Submit at monthly intervals.

I. Site Condition Reports: Submit at time of discovery of differing conditions.

J. Unusual Event Reports: Submit at time of unusual event.

K. Qualification Data: For scheduling consultant.

1.4 QUALITY ASSURANCE

A. Scheduling Consultant Qualifications: An experienced specialist in CPM scheduling and reporting, with capability of producing CPM reports and diagrams within 24 hours of Architect's request.

B. Prescheduling Conference: Conduct conference at Project site to comply with requirements in Section 013100 "Project Management and Coordination." Review methods and procedures related to the preliminary construction schedule and Contractor's Construction Schedule, including, but not limited to, the following:

1. Review software limitations and content and format for reports.
2. Verify availability of qualified personnel needed to develop and update schedule.
3. Discuss constraints, including phasing work stages area separations interim milestones and partial Owner occupancy.
4. Review delivery dates for Owner-furnished products.
5. Review schedule for work of Owner's separate contracts.
6. Review submittal requirements and procedures.
7. Review time required for review of submittals and resubmittals.
8. Review requirements for tests and inspections by independent testing and inspecting agencies.

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9. Review time required for Project closeout and Owner startup procedures , including commissioning activities.
10. Review and finalize list of construction activities to be included in schedule.
11. Review procedures for updating schedule.

1.5 COORDINATION

A. Coordinate Contractor's Construction Schedule with the schedule of values, submittal schedule, progress reports, payment requests, and other required schedules and reports.

1. Secure time commitments for performing critical elements of the Work from entities involved.
2. Coordinate each construction activity in the network with other activities, and schedule them in proper sequence.

1.6 CONTRACTOR'S CONSTRUCTION SCHEDULE

A. Computer Scheduling Software: Prepare schedules using current version of a program that is capable of managing construction schedules.

B. Time Frame: Extend schedule from date established for commencement of the Work to date of Final Completion .

1. Contract completion date to not be changed by submission of a schedule that shows an early completion date, unless specifically authorized by Change Order.

C. Activities: Treat each floor or separate area as a separate numbered activity for each main element of the Work. Comply with the following:

1. Activity Duration: Define activities so no activity is longer than 20 days, unless specifically allowed by Architect.
2. Temporary Facilities: Indicate start and completion dates for the following as applicable:

a. Securing of approvals and permits required for performance of the Work.
b. Temporary facilities.
c. Construction of mock-ups, prototypes and samples.
d. Owner interfaces and furnishing of items.
e. Interfaces with Separate Contracts.
f. Regulatory agency approvals.
g. Punch list.

3. Procurement Activities: Include procurement process activities for the following long lead-time items and major items, requiring a cycle of more than 60 days, as separate activities in schedule. Procurement cycle activities include, but are not limited to, submittals, approvals, purchasing, fabrication, and delivery.
4. Submittal Review Time: Include review and resubmittal times indicated in Section 013300 "Submittal Procedures" in schedule. Coordinate submittal review times in Contractor's Construction Schedule with submittal schedule.
5. Startup and Testing Time: Include no fewer than 15 days for startup and testing.
6. Commissioning Time: Include no fewer than 15 days for commissioning.
7. Substantial Completion: Indicate completion in advance of date established for Substantial Completion, and allow time for Architect's administrative procedures necessary for certification of Substantial Completion.
8. Punch List and Final Completion: Include not more than 30 days for completion of punch list items and Final Completion.

D. Constraints: Include constraints and work restrictions indicated in the Contract Documents and as follows in schedule, and show how the sequence of the Work is affected.

1. Phasing: Arrange list of activities on schedule by phase.
2. Work under More Than One Contract: Include a separate activity for each contract.
3. Work by Owner: Include a separate activity for each portion of the Work performed by Owner.
4. Products Ordered in Advance: Include a separate activity for each product. Include delivery date indicated in Section 011000 "Summary." Delivery dates indicated stipulate the earliest

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possible delivery date.

5. Owner-Furnished Products: Include a separate activity for each product. Include delivery date indicated in Section 011000 "Summary." Delivery dates indicated stipulate the earliest possible delivery date.
6. Work Restrictions: Show the effect of the following items on the schedule:

    a. Coordination with existing construction.
    b. Limitations of continued occupancies.
    c. Uninterruptible services.
    d. Partial occupancy before Substantial Completion.
    e. Use-of-premises restrictions.
    f. Provisions for future construction.
    g. Seasonal variations.
    h. Environmental control.

7. Work Stages: Indicate important stages of construction for each major portion of the Work, including, but not limited to, the following:

    a. Subcontract awards.
    b. Submittals.
    c. Purchases.
    d. Mockups.
    e. Fabrication.
    f. Sample testing.
    g. Deliveries.
    h. Installation.
    i. Tests and inspections.
    j. Adjusting.
    k. Curing.
    l. Building flush-out.
    m. Startup and placement into final use and operation.
    n. Commissioning.

8. Construction Areas: Identify each major area of construction for each major portion of the Work. Indicate where each construction activity within a major area must be sequenced or integrated with other construction activities to provide for the following:

    a. Structural completion.
    b. Temporary enclosure and space conditioning.
    c. Permanent space enclosure.
    d. Completion of mechanical installation.
    e. Completion of electrical installation.
    f. Substantial Completion.

E. Milestones: Include milestones indicated in the Contract Documents in schedule, including, but not limited to, the Notice to Proceed, Substantial Completion, and Final Completion [.]

F. Cost Correlation: Superimpose a cost correlation timeline, indicating planned and actual costs. On the line, show planned and actual dollar volume of the Work performed as of planned and actual dates used for preparation of payment requests.

    1. See Section 012900 "Payment Procedures" for cost reporting and payment procedures.

G. Upcoming Work Summary: Prepare summary report indicating activities scheduled to occur or commence prior to submittal of next schedule update. Summarize the following issues:

    1. Unresolved issues.
    2. Unanswered Requests for Information.
    3. Rejected or unreturned submittals.
    4. Notations on returned submittals.
    5. Pending modifications affecting the Work and the Contract Time.

H. Contractor's Construction Schedule Updating: At monthly intervals, update schedule to reflect actual construction progress and activities. Issue schedule one week before each regularly scheduled

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progress meeting.

1. Revise schedule immediately after each meeting or other activity where revisions have been recognized or made. Issue updated schedule concurrently with the report of each such meeting.
2. Include a report with updated schedule that indicates every change, including, but not limited to, changes in logic, durations, actual starts and finishes, and activity durations.
3. As the Work progresses, indicate Final Completion percentage for each activity.

I. Recovery Schedule: When periodic update indicates the Work is 14 or more calendar days behind the current approved schedule, submit a separate recovery schedule indicating means by which Contractor intends to regain compliance with the schedule. Indicate changes to working hours, working days, crew sizes, equipment required to achieve compliance, and date by which recovery will be accomplished.

J. Distribution: Distribute copies of approved schedule to Architect Owner, separate contractors, testing and inspecting agencies, and other parties identified by Contractor with a need-to-know schedule responsibility.

1. Post copies in Project meeting rooms and temporary field offices.
2. When revisions are made, distribute updated schedules to the same parties and post in the same locations. Delete parties from distribution when they have completed their assigned portion of the Work and are no longer involved in performance of construction activities.

1.7 STARTUP CONSTRUCTION SCHEDULE

A. Gantt-Chart Schedule: Submit startup, horizontal, Gantt-chart-type construction schedule within seven days of date established for the Notice of Award .

B. Preparation: Indicate each significant construction activity separately. Identify first workday of each week with a continuous vertical line. Outline significant construction activities for first 90 days of construction. Include skeleton diagram for the remainder of the Work and a cash requirement prediction based on indicated activities.

1.8 GANTT-CHART SCHEDULE REQUIREMENTS

A. Gantt-Chart Schedule: Submit a comprehensive, fully developed, horizontal, Gantt-chart-type, Contractor's Construction Schedule within 30 days of date established for the Notice of Award .

1. Base schedule on the startup construction schedule and additional information received since the start of Project.

B. Preparation: Indicate each significant construction activity separately. Identify first workday of each week with a continuous vertical line.

1. For construction activities that require three months or longer to complete, indicate an estimated completion percentage in 10 percent increments within time bar.

1.9 CPM SCHEDULE REQUIREMENTS

A. Prepare network diagrams using AON (activity-on-node) format.

B. Startup Network Diagram: Submit diagram within 14 days of date established for the Notice of Award . Outline significant construction activities for the first 90 days of construction. Include skeleton diagram for the remainder of the Work and a cash requirement prediction based on indicated activities.

C. CPM Schedule: Prepare Contractor's Construction Schedule using a time-scaled CPM network analysis diagram for the Work.

1. Develop network diagram in sufficient time to submit CPM schedule, so it can be accepted for use no later than 60 days after date established for the Notice of Award .

   a. Failure to include any work item required for performance of this Contract must not excuse Contractor from completing all work within applicable completion dates.

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2. Conduct educational workshops to train and inform key Project personnel, including subcontractors' personnel, in proper methods of providing data and using CPM schedule information.
3. Establish procedures for monitoring and updating CPM schedule and for reporting progress. Coordinate procedures with progress meeting and payment request dates.
4. Use "one workday" as the unit of time for individual activities. Indicate nonworking days and holidays incorporated into the schedule to coordinate with the Contract Time.

D. CPM Schedule Preparation: Prepare a list of all activities required to complete the Work. Using the startup network diagram, prepare a skeleton network to identify probable critical paths.

1. Activities: Indicate the estimated time duration, sequence requirements, and relationship of each activity in relation to other activities. Include estimated time frames for the following activities:

   a. Preparation and processing of submittals.
   b. Mobilization and demobilization.
   c. Purchase of materials.
   d. Delivery.
   e. Fabrication.
   f. Utility interruptions.
   g. Installation.
   h. Work by Owner that may affect or be affected by Contractor's activities.
   i. Testing and inspection.
   j. Commissioning.
   k. Punch list and Final Completion.
   l. Activities occurring following Final Completion.

2. Critical Path Activities: Identify critical path activities, including those for interim completion dates. Scheduled start and completion dates to be consistent with Contract milestone dates.
3. Processing: Process data to produce output data on a computer-drawn, time-scaled network. Revise data, reorganize activity sequences, and reproduce as often as necessary to produce the CPM schedule within the limitations of the Contract Time.
4. Format: Mark the critical path. Locate the critical path near center of network; locate paths with most float near the edges.

   a. Subnetworks on separate sheets are permissible for activities clearly off the critical path.

5. Cost- and Resource-Loading of CPM Schedule: Assign cost to construction activities on the CPM schedule. Do not assign costs to submittal activities. Obtain Architect's approval prior to assigning costs to fabrication and delivery activities. Assign costs under main subcontracts for testing and commissioning activities, operation and maintenance manuals, punch list activities, Project record documents, and demonstration and training (if applicable), in the amount of 5 percent of the Contract Sum.

   a. Each activity cost to reflect an appropriate value subject to approval by Architect.
   b. Total cost assigned to activities to equal the total Contract Sum.

E. Contract Modifications: For each proposed contract modification and concurrent with its submission, prepare a time-impact analysis using a network fragment to demonstrate the effect of the proposed change on the overall Project schedule.

F. Initial Issue of Schedule: Prepare initial network diagram from a sorted activity list indicating straight "early start-total float." Identify critical activities. Prepare tabulated reports showing the following:

1. Contractor or subcontractor and the Work or activity.
2. Description of activity.
3. Main events of activity.
4. Immediate preceding and succeeding activities.
5. Early and late start dates.
6. Early and late finish dates.
7. Activity duration in workdays.
8. Total float or slack time.
9. Average size of workforce.

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10. Dollar value of activity (coordinated with the schedule of values).

G. Schedule Updating: Concurrent with making revisions to schedule, prepare tabulated reports showing the following:

1. Identification of activities that have changed.
2. Changes in early and late start dates.
3. Changes in early and late finish dates.
4. Changes in activity durations in workdays.
5. Changes in the critical path.
6. Changes in total float or slack time.
7. Changes in the Contract Time.

H. Value Summaries: Prepare two cumulative value lists, sorted by finish dates.

1. In first list, tabulate activity number, early finish date, dollar value, and cumulative dollar value.
2. In second list, tabulate activity number, late finish date, dollar value, and cumulative dollar value.
3. In subsequent issues of both lists, substitute actual finish dates for activities completed as of list date.
4. Prepare list for ease of comparison with payment requests; coordinate timing with progress meetings.

   a. In both value summary lists, tabulate "actual percent complete" and "cumulative value completed" with total at bottom.
   b. Submit value summary printouts one week before each regularly scheduled progress meeting.

1.10 REPORTS

A. Daily Construction Reports: Prepare a daily construction report recording the following information concerning events at Project site:

1. List of subcontractors at Project site.
2. List of separate contractors at Project site.
3. Approximate count of personnel at Project site.
4. Equipment at Project site.
5. Material deliveries.
6. High and low temperatures and general weather conditions, including presence of rain or snow.
7. Testing and inspection.
8. Accidents.
9. Meetings and significant decisions.
10. Unusual events.
11. Stoppages, delays, shortages, and losses.
12. Meter readings and similar recordings.
13. Emergency procedures.
14. Orders and requests of authorities having jurisdiction.
15. Change Orders received and implemented.
16. Construction Change Directives received and implemented.
17. Services connected and disconnected.
18. Equipment or system tests and startups.
19. Partial completions and occupancies.
20. Substantial Completions authorized.

B. Material Location Reports: At monthly intervals, prepare and submit a comprehensive list of materials delivered to and stored at Project site. List to be cumulative, showing materials previously reported plus items recently delivered. Include with list a statement of progress on and delivery dates for materials or items of equipment fabricated or stored away from Project site. Indicate the following categories for stored materials:

1. Material stored prior to previous report and remaining in storage.
2. Material stored prior to previous report and since removed from storage and installed.
3. Material stored following previous report and remaining in storage.

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C. Site Condition Reports: Immediately on discovery of a difference between site conditions and the Contract Documents, prepare and submit a detailed report. Submit with a Request for Information. Include a detailed description of the differing conditions, together with recommendations for changing the Contract Documents.

D. Unusual Event Reports: When an event of an unusual and significant nature occurs at Project site, whether or not related directly to the Work, prepare and submit a special report. List chain of events, persons participating, responses by Contractor's personnel, evaluation of results or effects, and similar pertinent information. Advise Owner in advance when these events are known or predictable.

1. Submit unusual event reports directly to Owner within one day(s) of an occurrence. Distribute copies of report to parties affected by the occurrence.

PART 2 - PRODUCTS (Not Used)
PART 3 - EXECUTION (Not Used)

END OF SECTION 01 32 00

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SECTION 01 32 33 - PHOTOGRAPHIC DOCUMENTATION

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes administrative and procedural requirements for the following:

1. Preconstruction photographs.
2. Concealed Work photographs.
3. Periodic construction photographs.
4. Final Completion construction photographs.

B. Related Requirements:

1. Section 017700 "Closeout Procedures" for submitting photographic documentation as Project Record Documents at Project closeout.
2. Section 017900 "Demonstration and Training" for submitting video recordings of demonstration of equipment and training of Owner's personnel.
3. Section 024116 "Structure Demolition" for photographic documentation before building demolition operations commence.
4. Section 024119 "Selective Demolition" for photographic documentation before selective demolition operations commence.
5. Section 311000 "Site Clearing" for photographic documentation before site clearing operations commence.

1.2 INFORMATIONAL SUBMITTALS

A. Key Plan: Submit key plan of Project site and building with notation of vantage points marked for location and direction of each photograph . Indicate elevation or story of construction. Include same information as corresponding photographic documentation.

B. Digital Photographs: Submit image files within three days of taking photographs.

1. Submit photos by uploading to web-based Project management software site . Include copy of key plan indicating each photograph's location and direction.
2. Identification: Provide the following information with each image description in web-based Project management software site :

   a. Name of Project.
   b. Name and contact information for photographer.
   c. Name of Architect .
   d. Name of Contractor.
   e. Date photograph was taken.
   f. Description of location, vantage point, and direction.
   g. Unique sequential identifier keyed to accompanying key plan.

C. Time-Lapse Video: Submit time-lapse sequence video recordings within 7 days of recording.

1. Submit time-lapse sequence video recordings monthly by uploading to web-based Project management software site .
2. Identification: For each recording, provide the following information on web-based Project management software site :

   a. Name of Project.
   b. Name and contact information for photographer.
   c. Name of Architect .
   d. Name of Contractor.
   e. Date(s) and time(s) video recording was recorded.
   f. Description of vantage point, indicating location, direction (by compass point), and elevation or story of construction.

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1.3 QUALITY ASSURANCE

A. Photographer Qualifications: An individual who has been regularly engaged as a professional photographer of construction projects for not less than three years.

B. Construction Webcam Service Provider: A firm specializing in providing photographic equipment, web-based software, and related services for construction projects, with a record of providing satisfactory services similar to those required for Project.

1.4 CONSTRUCTION PHOTOGRAPHS

A. Photographer: Engage a qualified photographer to take construction photographs.

B. General: Take photographs with maximum depth of field and in focus.

1. Maintain key plan with each set of construction photographs that identifies each photographic location.

C. Preconstruction Photographs: Before commencement of the Work, take photographs of Project site and surrounding properties, including existing items to remain during construction, from different vantage points, as directed by Architect .

1. Flag construction limits before taking construction photographs.
2. Take 20 photographs to show existing conditions adjacent to property before starting the Work.
3. Take 20 photographs of existing buildings either on or adjoining property, to accurately record physical conditions at start of construction.
4. Take additional photographs as required to record settlement or cracking of adjacent structures, pavements, and improvements.

D. Concealed Work Photographs: Before proceeding with installing work that will conceal other work, take photographs sufficient in number, with annotated descriptions, to record nature and location of concealed Work, including, but not limited to, the following:

1. Underground utilities.
2. Underslab services.
3. Piping.
4. Electrical conduit.
5. Waterproofing and weather-resistant barriers.

E. Periodic Construction Photographs: Take 20 photographs weekly . Select vantage points to show status of construction and progress since last photographs were taken.

F. Final Completion Construction Photographs: Take 20 photographs after date of Substantial Completion for submission as Project Record Documents. Architect will inform photographer of desired vantage points.

PART 2 - PRODUCTS (Not Used)
PART 3 - EXECUTION (Not Used)

END OF SECTION 01 32 33

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SECTION 01 33 00 - SUBMITTAL PROCEDURES

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Submittal schedule requirements.
2. Administrative and procedural requirements for submittals.

B. Related Requirements:

1. Section 012900 "Payment Procedures" for submitting Applications for Payment and the schedule of values.
2. Section 013100 "Project Management and Coordination" for submitting coordination drawings and subcontract list and for requirements for web-based Project software.
3. Section 013200 "Construction Progress Documentation" for submitting schedules and reports, including Contractor's construction schedule.
4. Section 013233 "Photographic Documentation" for submitting preconstruction photographs, periodic construction photographs, and Final Completion construction photographs.
5. Section 014000 "Quality Requirements" for submitting test and inspection reports, and schedule of tests and inspections.
6. Section 017700 "Closeout Procedures" for submitting closeout submittals and maintenance material submittals.
7. Section 017823 "Operation and Maintenance Data" for submitting operation and maintenance manuals.
8. Section 017839 "Project Record Documents" for submitting record Drawings, record Specifications, and record Product Data.
9. Section 017900 "Demonstration and Training" for submitting video recordings of demonstration of equipment and training of Owner's personnel.

1.2 DEFINITIONS

A. Action Submittals: Written and graphic information and physical samples that require Architect's responsive action. Action submittals are those submittals indicated in individual Specification Sections as "action submittals."

B. Informational Submittals: Written and graphic information and physical samples that do not require Architect's responsive action. Submittals may be rejected for not complying with requirements. Informational submittals are those submittals indicated in individual Specification Sections as "informational submittals."

1.3 SUBMITTAL SCHEDULE

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

1. Coordinate submittal schedule with list of subcontracts, the schedule of values, and Contractor's construction schedule.
2. Initial Submittal Schedule: Submit concurrently with startup construction schedule. Include submittals required during the first 60 days of construction. List those submittals required to maintain orderly progress of the Work and those required early because of long lead time for manufacture or fabrication.
3. Final Submittal Schedule: Submit concurrently with the first complete submittal of Contractor's construction schedule.

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a. Submit revised submittal schedule as required to reflect changes in current status and timing for submittals.

4. Format: Arrange the following information in a tabular format:

a. Scheduled date for first submittal.
b. Specification Section number and title.
c. Submittal Category: Action; informational.
d. Name of subcontractor.
e. Description of the Work covered.
f. Scheduled date for Architect's final release or approval.
g. Scheduled dates for purchasing.
h. Scheduled date of fabrication.
i. Scheduled dates for installation.
j. Activity or event number.

1.4 SUBMITTAL FORMATS

A. Submittal Information: Include the following information in each submittal:

1. Project name.
2. Date.
3. Name of Architect.
4. Name of Construction Manager.
5. Name of Contractor.
6. Name of firm or entity that prepared submittal.
7. Names of subcontractor, manufacturer, and supplier.
8. Unique submittal number, including revision identifier. Include Specification Section number with sequential alphanumeric identifier and alphanumeric suffix for resubmittals.
9. Category and type of submittal.
10. Submittal purpose and description.
11. Number and title of Specification Section, with paragraph number and generic name for each of multiple items.
12. Drawing number and detail references, as appropriate.
13. Indication of full or partial submittal.
14. Location(s) where product is to be installed, as appropriate.
15. Other necessary identification.
16. Remarks.
17. Signature of transmitter.

B. Options: Identify options requiring selection by Architect.

C. Deviations and Additional Information: On each submittal, clearly indicate deviations from requirements in the Contract Documents, including minor variations and limitations; include relevant additional information and revisions, other than those requested by Architect on previous submittals. Indicate by highlighting on each submittal or noting on attached separate sheet.

D. Electronic Submittals: Prepare submittals as PDF package, incorporating complete information into each PDF file. Name PDF file with submittal number.

E. Submittals Utilizing Web-Based Project Software: Prepare submittals as PDF files or other format indicated by Project management software.

1.5 SUBMITTAL PROCEDURES

A. Prepare and submit submittals required by individual Specification Sections. Types of submittals are indicated in individual Specification Sections.

1. Email: Prepare submittals as PDF package and transmit to Architect by sending via email. Include PDF transmittal form. Include information in email subject line as requested by Architect.

a. Architect will return annotated file. Annotate and retain one copy of file as a digital

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Project Record Document file.

2. Web-Based Project Management Software: Prepare submittals in PDF form, and upload to web-based Project management software website. Enter required data in web-based software site to fully identify submittal.
3. Paper: Prepare submittals in paper form and deliver to Architect.

B. Coordination: Coordinate preparation and processing of submittals with performance of construction activities.

1. Coordinate each submittal with fabrication, purchasing, testing, delivery, other submittals, and related activities that require sequential activity.
2. Submit all submittal items required for each Specification Section concurrently unless partial submittals for portions of the Work are indicated on approved submittal schedule.
3. Submit action submittals and informational submittals required by the same Specification Section as separate packages under separate transmittals.
4. Coordinate transmittal of submittals for related parts of the Work specified in different Sections, so processing will not be delayed because of need to review submittals concurrently for coordination.

    a. Architect reserves the right to withhold action on a submittal requiring coordination with other submittals until related submittals are received.

C. Processing Time: Allow time for submittal review, including time for resubmittals, as follows. Time for review shall commence on Architect's receipt of submittal. No extension of the Contract Time will be authorized because of failure to transmit submittals enough in advance of the Work to permit processing, including resubmittals.

1. Initial Review: Allow 15 days for initial review of each submittal. Allow additional time if coordination with subsequent submittals is required. Architect will advise Contractor when a submittal being processed must be delayed for coordination.
2. Intermediate Review: If intermediate submittal is necessary, process it in same manner as initial submittal.
3. Resubmittal Review: Allow 15 days for review of each resubmittal.
4. Sequential Review: Where sequential review of submittals by Architect's consultants, Owner, or other parties is indicated, allow 21 days for initial review of each submittal.
5. Concurrent Consultant Review: Where the Contract Documents indicate that submittals may be transmitted simultaneously to Architect and to Architect's consultants, allow 15 days for review of each submittal. Submittal will be returned to Architect before being returned to Contractor.

    a. Submit one copy of submittal to concurrent reviewer in addition to specified number of copies to Architect .

D. Resubmittals: Make resubmittals in same form and number of copies as initial submittal.

1. Note date and content of previous submittal.
2. Note date and content of revision in label or title block, and clearly indicate extent of revision.
3. Resubmit submittals until they are marked with approval notation from Architect's action stamp.

E. Distribution: Furnish copies of final submittals to manufacturers, subcontractors, suppliers, fabricators, installers, authorities having jurisdiction, and others as necessary for performance of construction activities. Show distribution on transmittal forms.

F. Use for Construction: Retain complete copies of submittals on Project site. Use only final action submittals that are marked with approval notation from Architect's action stamp.

1.6 SUBMITTAL REQUIREMENTS

A. Product Data: Collect information into a single submittal for each element of construction and type of product or equipment.

1. If information must be specially prepared for submittal because standard published data are unsuitable for use, submit as Shop Drawings, not as Product Data.
2. Mark each copy of each submittal to show which products and options are applicable.

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3. Include the following information, as applicable:

    a. Manufacturer's catalog cuts.
    b. Manufacturer's product specifications.
    c. Standard color charts.
    d. Statement of compliance with specified referenced standards.
    e. Testing by recognized testing agency.
    f. Application of testing agency labels and seals.
    g. Notation of coordination requirements.
    h. Availability and delivery time information.

4. For equipment, include the following in addition to the above, as applicable:

    a. Wiring diagrams that show factory-installed wiring.
    b. Printed performance curves.
    c. Operational range diagrams.
    d. Clearances required to other construction, if not indicated on accompanying Shop Drawings.

5. Submit Product Data before Shop Drawings, and before or concurrently with Samples.

B. Shop Drawings: Prepare Project-specific information, drawn accurately to scale. Do not base Shop Drawings on reproductions of the Contract Documents or standard printed data unless submittal based on Architect's digital data drawing files is otherwise permitted.

1. Preparation: Fully illustrate requirements in the Contract Documents. Include the following information, as applicable:

    a. Identification of products.
    b. Schedules.
    c. Compliance with specified standards.
    d. Notation of coordination requirements.
    e. Notation of dimensions established by field measurement.
    f. Relationship and attachment to adjoining construction clearly indicated.
    g. Seal and signature of professional engineer if specified.

C. Samples: Submit Samples for review of type, color, pattern, and texture for a check of these characteristics with other materials.

1. Transmit Samples that contain multiple, related components, such as accessories together in one submittal package.
2. Identification: Permanently attach label on unexposed side of Samples that includes the following:

    a. Project name and submittal number.
    b. Generic description of Sample.
    c. Product name and name of manufacturer.
    d. Sample source.
    e. Number and title of applicable Specification Section.
    f. Specification paragraph number and generic name of each item.

3. Email Transmittal: Provide PDF transmittal. Include digital image file illustrating Sample characteristics and identification information for record.
4. Web-Based Project Management Software: Prepare submittals in PDF form, and upload to web-based Project software website. Enter required data in web-based software site to fully identify submittal.
5. Paper Transmittal: Include paper transmittal, including complete submittal information indicated.
6. Disposition: Maintain sets of approved Samples at Project site, available for quality-control comparisons throughout the course of construction activity. Sample sets may be used to determine final acceptance of construction associated with each set.

    a. Samples that may be incorporated into the Work are indicated in individual Specification Sections. Such Samples must be in an undamaged condition at time of use.
    b. Samples not incorporated into the Work, or otherwise designated as Owner's property, are the property of Contractor.

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7. Samples for Initial Selection: Submit manufacturer's color charts consisting of units or sections of units, showing the full range of colors, textures, and patterns available.

    a. Number of Samples: Submit one full set(s) of available choices where color, pattern, texture, or similar characteristics are required to be selected from manufacturer's product line. Architect will return submittal with options selected.

8. Samples for Verification: Submit full-size units or Samples of size indicated, prepared from same material to be used for the Work, cured and finished in manner specified, and physically identical with material or product proposed for use, and that show full range of color and texture variations expected. Samples include, but are not limited to, the following: partial sections of manufactured or fabricated components; small cuts or containers of materials; complete units of repetitively used materials; swatches showing color, texture, and pattern; color range sets; and components used for independent testing and inspection.

    a. Number of Samples: Submit 2 sets of Samples. Architect will retain 1 Sample sets; remainder will be returned. Mark up and retain one returned Sample set as a project record Sample.

        1) Submit a single Sample where assembly details, workmanship, fabrication techniques, connections, operation, and other similar characteristics are to be demonstrated.
        2) If variation in color, pattern, texture, or other characteristic is inherent in material or product represented by a Sample, submit at least three sets of paired units that show approximate limits of variations.

D. Product Schedule: As required in individual Specification Sections, prepare a written summary indicating types of products required for the Work and their intended location. Include the following information in tabular form:

1. Type of product. Include unique identifier for each product indicated in the Contract Documents or assigned by Contractor if none is indicated.
2. Manufacturer and product name, and model number if applicable.
3. Number and name of room or space.
4. Location within room or space.

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

F. Design Data: Prepare and submit written and graphic information indicating compliance with indicated performance and design criteria in individual Specification Sections. Include list of assumptions and summary of loads. Include load diagrams if applicable. Provide name and version of software, if any, used for calculations. Number each page of submittal.

G. Certificates:

1. Certificates and Certifications Submittals: Submit a statement that includes signature of entity responsible for preparing certification. Certificates and certifications shall be signed by an officer or other individual authorized to sign documents on behalf of that entity. Provide a notarized signature where indicated.
2. Installer Certificates: Submit written statements on manufacturer's letterhead, certifying that Installer complies with requirements in the Contract Documents and, where required, is authorized by manufacturer for this specific Project.
3. Manufacturer Certificates: Submit written statements on manufacturer's letterhead, certifying that manufacturer complies with requirements in the Contract Documents. Include evidence of manufacturing experience where required.
4. Material Certificates: Submit written statements on manufacturer's letterhead, certifying that material complies with requirements in the Contract Documents.
5. Product Certificates: Submit written statements on manufacturer's letterhead, certifying that product complies with requirements in the Contract Documents.
6. Welding Certificates: Prepare written certification that welding procedures and personnel comply with requirements in the Contract Documents. Submit record of AWS B2.1/B2.1M on AWS forms. Include names of firms and personnel certified.

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H. Test and Research Reports:

1. Compatibility Test Reports: Submit reports written by a qualified testing agency, on testing agency's standard form, indicating and interpreting results of compatibility tests performed before installation of product. Include written recommendations for substrate preparation and primers required.
2. Field Test Reports: Submit written reports indicating and interpreting results of field tests performed either during installation of product or after product is installed in its final location, for compliance with requirements in the Contract Documents.
3. Material Test Reports: Submit reports written by a qualified testing agency, on testing agency's standard form, indicating and interpreting test results of material for compliance with requirements in the Contract Documents.
4. Preconstruction Test Reports: Submit reports written by a qualified testing agency, on testing agency's standard form, indicating and interpreting results of tests performed before installation of product, for compliance with performance requirements in the Contract Documents.
5. Product Test Reports: Submit written reports indicating that current product produced by manufacturer complies with requirements in the Contract Documents. Base reports on evaluation of tests performed by manufacturer and witnessed by a qualified testing agency, or on comprehensive tests performed by a qualified testing agency.
6. Research Reports: Submit written evidence, from a model code organization acceptable to authorities having jurisdiction, that product complies with building code in effect for Project. Include the following information:

    a. Name of evaluation organization.
    b. Date of evaluation.
    c. Time period when report is in effect.
    d. Product and manufacturers' names.
    e. Description of product.
    f. Test procedures and results.
    g. Limitations of use.

1.7 DELEGATED DESIGN SERVICES

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

1. If criteria indicated are insufficient to perform services or certification required, submit a written request for additional information to Architect.

B. Delegated Design Services Certification: In addition to Shop Drawings, Product Data, and other required submittals, submit digitally signed PDF file paper copies of certificate, signed and sealed by the responsible design professional, for each product and system specifically assigned to Contractor to be designed or certified by a design professional.

1. Indicate that products and systems comply with performance and design criteria in the Contract Documents. Include list of codes, loads, and other factors used in performing these services.

1.8 CONTRACTOR'S REVIEW

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

B. Contractor's Approval: Indicate Contractor's approval for each submittal with a uniform approval stamp. Include name of reviewer, date of Contractor's approval, and statement certifying that submittal has been reviewed, checked, and approved for compliance with the Contract Documents.

1. Architect will not review submittals received from Contractor that do not have Contractor's review and approval.

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1.9 ARCHITECT'S REVIEW

A. Action Submittals: Architect will review each submittal, indicate corrections or revisions required , and return.

1. PDF Submittals: Architect will indicate, via markup on each submittal, the appropriate action .
2. Submittals by Web-Based Project Management Software: Architect will indicate, on Project management software website, the appropriate action.

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

C. Partial submittals prepared for a portion of the Work will be reviewed when use of partial submittals has received prior approval from Architect.

D. Incomplete submittals are unacceptable, will be considered nonresponsive, and will be returned for resubmittal without review.

E. Architect will discard submittals received from sources other than Contractor.

F. Submittals not required by the Contract Documents will be returned by Architect without action.

PART 2 - PRODUCTS (Not Used)
PART 3 - EXECUTION (Not Used)

END OF SECTION 01 33 00

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SECTION 01 40 00 - QUALITY REQUIREMENTS

PART 1 - GENERAL

1.1 SUMMARY

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

B. Testing and inspection services are required to verify compliance with requirements specified or indicated. These services do not relieve Contractor of responsibility for compliance with the Contract Document requirements.

1. Specific quality-assurance and quality-control requirements for individual work results are specified in their respective Specification Sections. Requirements in individual Sections may also cover production of standard products.
2. Specified tests, inspections, and related actions do not limit Contractor's other quality-assurance and quality-control procedures that facilitate compliance with the Contract Document requirements.
3. Requirements for Contractor to provide quality-assurance and quality-control services required by Architect, Owner, or authorities having jurisdiction are not limited by provisions of this Section.

1.2 DEFINITIONS

A. Experienced: When used with an entity or individual, "experienced," unless otherwise further described, means having successfully completed a minimum of five previous projects similar in nature, size, and extent to this Project; being familiar with special requirements indicated; and having complied with requirements of authorities having jurisdiction.

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

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

1. Use of trade-specific terminology in referring to a Work result does not require that certain construction activities specified apply exclusively to specific trade(s).

D. Mockups: Physical assemblies of portions of the Work constructed to establish the standard by which the Work will be judged. Mockups are not Samples.

1. Mockups are used for one or more of the following:

a. Verify selections made under Sample submittals.
b. Demonstrate aesthetic effects.
c. Demonstrate the qualities of products and workmanship.
d. Demonstrate successful installation of interfaces between components and systems.
e. Perform preconstruction testing to determine system performance.

2. Product Mockups: Mockups that may include multiple products, materials, or systems specified in a single Section.
3. In-Place Mockups: Mockups constructed on-site in their actual final location as part of permanent construction.

E. Preconstruction Testing: Tests and inspections performed specifically for Project before products and materials are incorporated into the Work, to verify performance or compliance with specified criteria. Unless otherwise indicated, copies of reports of tests or inspections performed for other than the Project do not meet this definition.

F. Product Tests: Tests and inspections that are performed by a nationally recognized testing laboratory (NRTL) in accordance with 29 CFR 1910.7, by a testing agency accredited in accordance with NIST's

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National Voluntary Laboratory Accreditation Program (NVLAP), or by a testing agency qualified to conduct product testing and acceptable to authorities having jurisdiction, to establish product performance and compliance with specified requirements.

G. Source Quality-Control Tests and Inspections: Tests and inspections that are performed at the source (e.g., plant, mill, factory, or shop).

H. Testing Agency: An entity engaged to perform specific tests, inspections, or both. The term "testing laboratory" has the same meaning as the term "testing agency."

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

J. Quality-Control Services: Tests, inspections, procedures, and related actions during and after execution of the Work, to evaluate that actual products incorporated into the Work and completed construction comply with requirements. Contractor's quality-control services do not include contract administration activities performed by Architect .

1.3 DELEGATED DESIGN SERVICES

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

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

B. Delegated Design Services Statement: Submit a statement signed and sealed by the responsible design professional, for each product and system specifically assigned to Contractor to be designed or certified by a design professional, indicating that the products and systems are in compliance with performance and design criteria indicated. Include list of codes, loads, and other factors used in performing these services.

1.4 CONFLICTING REQUIREMENTS

A. Conflicting Standards and Other Requirements: If compliance with two or more standards or requirements is specified and the standards or requirements establish different or conflicting requirements for minimum quantities or quality levels, inform the Architect regarding the conflict and obtain clarification prior to proceeding with the Work. Refer conflicting requirements that are different, but apparently equal, to Architect for clarification before proceeding.

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

1.5 INFORMATIONAL SUBMITTALS

A. Qualification Data: For Contractor's quality-control personnel.

B. Contractor's Statement of Responsibility: When required by authorities having jurisdiction, submit copy of written statement of responsibility submitted to authorities having jurisdiction before starting work on the following systems:

1. Seismic-force-resisting system, designated seismic system, or component listed in the Statement of Special Inspections.
2. Primary wind-force-resisting system or a wind-resisting component listed in the Statement of Special Inspections.

C. Testing Agency Qualifications: For testing agencies specified in "Quality Assurance" Article to demonstrate their capabilities and experience. Include proof of qualifications in the form of a recent

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report on the inspection of the testing agency by a recognized authority.

D. Schedule of Tests and Inspections: Prepare in tabular form and include the following:

1. Specification Section number and title.
2. Entity responsible for performing tests and inspections.
3. Description of test and inspection.
4. Identification of applicable standards.
5. Identification of test and inspection methods.
6. Number of tests and inspections required.
7. Time schedule or time span for tests and inspections.
8. Requirements for obtaining samples.
9. Unique characteristics of each quality-control service.

E. Reports: Prepare and submit certified written reports and documents as specified.

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

1.6 CONTRACTOR'S QUALITY-CONTROL PLAN

A. Quality-Control Plan, General: Submit quality-control plan within 10 days of Notice of Award , and not less than five days prior to preconstruction conference. Submit in format acceptable to Architect. Identify personnel, procedures, controls, instructions, tests, records, and forms to be used to carry out Contractor's quality-assurance and quality-control responsibilities and to coordinate Owner's quality-assurance and quality-control activities. Coordinate with Contractor's Construction Schedule.

B. Quality-Control Personnel Qualifications: Engage qualified personnel trained and experienced in managing and executing quality-assurance and quality-control procedures similar in nature and extent to those required for Project.

1. Project quality-control manager may also serve as Project superintendent .

C. Submittal Procedure: Describe procedures for ensuring compliance with requirements through review and management of submittal process. Indicate qualifications of personnel responsible for submittal review.

D. Testing and Inspection: In quality-control plan, include a comprehensive schedule of Work requiring testing or inspection, including the following:

1. Contractor-performed tests and inspections, including subcontractor-performed tests and inspections. Include required tests and inspections and Contractor-elected tests and inspections. Distinguish source quality-control tests and inspections from field quality-control tests and inspections.
2. Special inspections required by authorities having jurisdiction and indicated on the Statement of Special Inspections.
3. Owner-performed tests and inspections indicated in the Contract Documents .

E. Continuous Inspection of Workmanship: Describe process for continuous inspection during construction to identify and correct deficiencies in workmanship in addition to testing and inspection specified. Indicate types of corrective actions to be required to bring the Work into compliance with standards of workmanship established by Contract requirements and approved mockups.

F. Monitoring and Documentation: Maintain testing and inspection reports, including log of approved and rejected results. Include Work Architect has indicated as nonconforming or defective. Indicate corrective actions taken to bring nonconforming Work into compliance with requirements. Comply with requirements of authorities having jurisdiction.

1.7 REPORTS AND DOCUMENTS

A. Test and Inspection Reports: Prepare and submit certified written reports specified in other Sections. Include the following:

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

B. Manufacturer's Technical Representative's Field Reports: Prepare written information documenting manufacturer's technical representative's tests and inspections specified in other Sections. Include the following:

1. Name, address, telephone number, and email address of technical representative making report.
2. Statement on condition of substrates and their acceptability for installation of product.
3. Statement that products at Project site comply with requirements.
4. Summary of installation procedures being followed, whether they comply with requirements and, if not, what corrective action was taken.
5. Results of operational and other tests and a statement of whether observed performance complies with requirements.
6. Statement of whether conditions, products, and installation will affect warranty.
7. Other required items indicated in individual Specification Sections.

C. Factory-Authorized Service Representative's Reports: Prepare written information documenting manufacturer's factory-authorized service representative's tests and inspections specified in other Sections. Include the following:

1. Name, address, telephone number, and email address of factory-authorized service representative making report.
2. Statement that equipment complies with requirements.
3. Results of operational and other tests and a statement of whether observed performance complies with requirements.
4. Statement of whether conditions, products, and installation will affect warranty.
5. Other required items indicated in individual Specification Sections.

1.8 QUALITY ASSURANCE

A. Qualifications paragraphs in this article establish the minimum qualification levels required; individual Specification Sections specify additional requirements.

B. Manufacturer Qualifications: A firm experienced in manufacturing products or systems similar to those indicated for this Project and with a record of successful in-service performance, as well as sufficient production capacity to produce required units. As applicable, procure products from manufacturers able to meet qualification requirements, warranty requirements, and technical or factory-authorized service representative requirements.

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

D. Installer Qualifications: A firm or individual experienced in installing, erecting, applying, or assembling work similar in material, design, and extent to that indicated for this Project, whose work has resulted in construction with a record of successful in-service performance.

E. Professional Engineer Qualifications: A professional engineer who is legally qualified to practice in

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jurisdiction where Project is located and who is experienced in providing engineering services of the kind indicated. Engineering services are defined as those performed for installations of the system, assembly, or product that is similar in material, design, and extent to those indicated for this Project.

F. Specialists: Certain Specification Sections require that specific construction activities be performed by entities who are recognized experts in those operations. Specialists will satisfy qualification requirements indicated and engage in the activities indicated.

1. Requirements of authorities having jurisdiction supersede requirements for specialists.

G. Testing and Inspecting Agency Qualifications: An NRTL, an NVLAP, or an independent agency with the experience and capability to conduct testing and inspection indicated, as documented in accordance with ASTM E329, and with additional qualifications specified in individual Sections; and, where required by authorities having jurisdiction, that is acceptable to authorities.

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

I. Factory-Authorized Service Representative Qualifications: An authorized representative of manufacturer who is trained and approved by manufacturer to inspect, demonstrate, repair, and perform service on installations of manufacturer's products that are similar in material, design, and extent to those indicated for this Project.

J. Preconstruction Testing: Where testing agency is indicated to perform preconstruction testing for compliance with specified requirements for performance and test methods, comply with the following:

1. Contractor's Responsibilities:

a. Provide test specimens representative of proposed products and construction.
b. Submit specimens in a timely manner with sufficient time for testing and analyzing results to prevent delaying the Work.
c. Provide sizes and configurations of test assemblies, mockups, and laboratory mockups to adequately demonstrate capability of products to comply with performance requirements.
d. Build site-assembled test assemblies and mockups, using installers who will perform same tasks for Project.
e. When testing is complete, remove test specimens and test assemblies , and mockups; do not reuse products on Project.

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

K. Mockups: Before installing portions of the Work requiring mockups, build mockups for each form of construction and finish required to comply with the following requirements, using materials indicated for the completed Work:

1. Build mockups of size indicated.
2. Build mockups in location indicated or, if not indicated, as directed by Architect .
3. Notify Architect seven days in advance of dates and times when mockups will be constructed.
4. Employ supervisory personnel who will oversee mockup construction. Employ workers who will be employed to perform same tasks during the construction at Project.
5. Demonstrate the proposed range of aesthetic effects and workmanship.
6. Obtain Architect's approval of mockups before starting corresponding Work, fabrication, or construction.

a. Allow seven days for initial review and each re-review of each mockup.

7. Promptly correct unsatisfactory conditions noted by Architect's preliminary review, to the satisfaction of the Architect, before completion of final mockup.
8. Approval of mockups by the Architect does not constitute approval of deviations from the Contract Documents contained in mockups unless Architect specifically approves such deviations in writing.

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9. Maintain mockups during construction in an undisturbed condition as a standard for judging the completed Work.
10. Demolish and remove mockups when directed unless otherwise indicated.

1.9 QUALITY CONTROL

A. Owner Responsibilities: Where quality-control services are indicated as Owner's responsibility, Owner will engage a qualified testing agency to perform these services.

1. Owner will furnish Contractor with names, addresses, and telephone numbers of testing agencies engaged and a description of types of testing and inspection they are engaged to perform.
2. Payment for these services will be made from testing and inspection allowances specified in Section 012100 "Allowances," as authorized by Change Orders.
3. Costs for retesting and reinspecting construction that replaces or is necessitated by Work that failed to comply with the Contract Documents will be charged to Contractor .

B. Contractor Responsibilities: Tests and inspections not explicitly assigned to Owner are Contractor's responsibility. Perform additional quality-control activities, whether specified or not, to verify and document that the Work complies with requirements.

1. Unless otherwise indicated, provide quality-control services specified and those required by authorities having jurisdiction. Perform quality-control services required of Contractor by authorities having jurisdiction, whether specified or not.
2. Engage a qualified testing agency to perform quality-control services.

   a. Contractor will not employ same entity engaged by Owner, unless agreed to in writing by Owner.

3. Notify testing agencies at least 24 hours in advance of time when Work that requires testing or inspection will be performed.
4. Where quality-control services are indicated as Contractor's responsibility, submit a certified written report, in duplicate, of each quality-control service.
5. Testing and inspection requested by Contractor and not required by the Contract Documents are Contractor's responsibility.
6. Submit additional copies of each written report directly to authorities having jurisdiction, when they so direct.

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

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

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

E. Manufacturer's Field Services: Where indicated, engage a factory-authorized service representative to inspect field-assembled components and equipment installation, including service connections. Report results in writing as specified in Section 013300 "Submittal Procedures."

F. Manufacturer's Technical Services: Where indicated, engage a manufacturer's technical representative to observe and inspect the Work. Manufacturer's technical representative's services include participation in preinstallation conferences, examination of substrates and conditions, verification of

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materials, observation of Installer activities, inspection of completed portions of the Work, and submittal of written reports.

G. Contractor's Associated Requirements and Services: Cooperate with agencies and representatives performing required tests, inspections, and similar quality-control services, and provide reasonable auxiliary services as requested. Notify agency sufficiently in advance of operations to permit assignment of personnel. Provide the following:

1. Access to the Work.
2. Incidental labor and facilities necessary to facilitate tests and inspections.
3. Adequate quantities of representative samples of materials that require testing and inspection. Assist agency in obtaining samples.
4. Facilities for storage and field curing of test samples.
5. Delivery of samples to testing agencies.
6. Preliminary design mix proposed for use for material mixes that require control by testing agency.
7. Security and protection for samples and for testing and inspection equipment at Project site.

H. 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 inspection.

1. Schedule times for tests, inspections, obtaining samples, and similar activities.

I. Schedule of Tests and Inspections: Prepare a schedule of tests, inspections, and similar quality-control services required by the Contract Documents . Coordinate and submit concurrently with Contractor's Construction Schedule. Update and submit with each Application for Payment.

1. Schedule Contents: Include tests, inspections, and quality-control services, including Contractor- and Owner-retained services, commissioning activities, and other Project-required services paid for by other entities.
2. Distribution: Distribute schedule to Owner, Architect, testing agencies, and each party involved in performance of portions of the Work where tests and inspections are required.

1.10 SPECIAL TESTS AND INSPECTIONS

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

1. Verifying that manufacturer maintains detailed fabrication and quality-control procedures, and reviewing the completeness and adequacy of those procedures to perform the Work.
2. Notifying Architect and Contractor promptly of irregularities and deficiencies observed in the Work during performance of its services.
3. Submitting a certified written report of each test, inspection, and similar quality-control service to Architect with copy to Contractor and to authorities having jurisdiction.
4. Submitting a final report of special tests and inspections at Substantial Completion, which includes a list of unresolved deficiencies.
5. Interpreting tests and inspections, and stating in each report whether tested and inspected Work complies with or deviates from the Contract Documents.
6. Retesting and reinspecting corrected Work.

PART 2 - PRODUCTS (Not Used)
PART 3 - EXECUTION

3.1 TEST AND INSPECTION LOG

A. Test and Inspection Log: Prepare a record of tests and inspections. Include the following:

1. Date test or inspection was conducted.
2. Description of the Work tested or inspected.
3. Date test or inspection results were transmitted to Architect.
4. Identification of testing agency or special inspector conducting test or inspection.

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B. Maintain log at Project site. Post changes and revisions as they occur. Provide access to test and inspection log for Architect's reference during normal working hours.

1. Submit log at Project closeout as part of Project Record Documents.

3.2 REPAIR AND PROTECTION

A. General: On completion of testing, inspection, sample-taking, and similar services, repair damaged construction and restore substrates and finishes.

1. Provide materials and comply with installation requirements specified in other Specification Sections or matching existing substrates and finishes. Restore patched areas and extend restoration into adjoining areas with durable seams that are as invisible as possible. Comply with the Contract Document requirements for cutting and patching in Section 017300 "Execution."

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

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

END OF SECTION 01 40 00

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SECTION 01 42 00 - REFERENCES

PART 1 - GENERAL

1.1 DEFINITIONS

A. General: Basic Contract definitions are included in the Conditions of the Contract.

B. "Approved": When used to convey Architect's action on Contractor's submittals, applications, and requests, "approved" is limited to Architect's duties and responsibilities as stated in the Conditions of the Contract.

C. "Directed": A command or instruction by Architect. Other terms, including "requested," "authorized," "selected," "required," and "permitted," have the same meaning as "directed."

D. "Indicated": Requirements expressed by graphic representations or in written form on Drawings, in Specifications, and in other Contract Documents. Other terms, including "shown," "noted," "scheduled," and "specified," have the same meaning as "indicated."

E. "Regulations": Laws, ordinances, statutes, and lawful orders issued by authorities having jurisdiction, and rules, conventions, and agreements within the construction industry that control performance of the Work.

F. "Furnish": Supply and deliver to Project site, ready for unloading, unpacking, assembly, installation, and similar operations.

G. "Install": Unload, temporarily store, unpack, assemble, erect, place, anchor, apply, work to dimension, finish, cure, protect, clean, and similar operations at Project site.

H. "Provide": Furnish and install, complete and ready for the intended use.

I. "Project Site": Space available for performing construction activities. The extent of Project site is shown on Drawings and may or may not be identical with the description of the land on which Project is to be built.

1.2 INDUSTRY STANDARDS

A. Applicability of Standards: Unless the Contract Documents include more stringent requirements, applicable construction industry standards have the same force and effect as if bound or copied directly into the Contract Documents to the extent referenced. Such standards are made a part of the Contract Documents by reference.

B. Publication Dates: Comply with standards in effect as of date of the Contract Documents unless otherwise indicated.

1. For standards referenced by applicable building codes, comply with dates of standards as listed in building codes.

C. Copies of Standards: Each entity engaged in construction on Project should be familiar with industry standards applicable to its construction activity. Copies of applicable standards are not bound with the Contract Documents.

1. Where copies of standards are needed to perform a required construction activity, obtain copies directly from publication source.

1.3 ABBREVIATIONS AND ACRONYMS

A. Industry Organizations: Where abbreviations and acronyms are used in Specifications or other Contract Documents, they are to mean the recognized name of the entities indicated in Gale's "Encyclopedia of Associations: National Organizations of the U.S." or in Columbia Books' "National Trade & Professional Associations of the United States."

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B. Industry Organizations, List: Where abbreviations and acronyms are used in Specifications or other Contract Documents, they are to mean the recognized name of the entities in the following list. The information in this list is subject to change and is believed to be accurate as of the date of the Contract Documents.

1. AABC - Associated Air Balance Council; www.aabc.com.
2. AAMA - American Architectural Manufacturers Association; (see FGIA).
3. AAPFCO - Association of American Plant Food Control Officials; www.aapfco.org.
4. AASHTO - American Association of State Highway and Transportation Officials; www.transportation.org.
5. AATCC - American Association of Textile Chemists and Colorists; www.aatcc.org.
6. ABMA - American Bearing Manufacturers Association; www.americanbearings.org.
7. ABMA - American Boiler Manufacturers Association; www.abma.com.
8. ACI - American Concrete Institute; www.concrete.org.
9. ACP - American Clean Power; (Formerly: American Wind Energy Association); www.cleanpower.org.
10. ACPA - American Concrete Pipe Association; www.concretepipe.org.
11. AEIC - Association of Edison Illuminating Companies, Inc. (The); www.aeic.org.
12. AF&PA - American Forest & Paper Association; www.afandpa.org.
13. AGA - American Gas Association; www.aga.org.
14. AHAM - Association of Home Appliance Manufacturers; www.aham.org.
15. AHRI - Air-Conditioning, Heating, and Refrigeration Institute (The); www.ahrinet.org.
16. AI - Asphalt Institute; www.asphaltinstitute.org.
17. AIA - American Institute of Architects (The); www.aia.org.
18. AISC - American Institute of Steel Construction; www.aisc.org.
19. AISI - American Iron and Steel Institute; www.steel.org.
20. AITC - American Institute of Timber Construction; (see PLIB).
21. AMCA - Air Movement and Control Association International, Inc.; www.amca.org.
22. AMPP - Association for Materials Protection and Performance; www.ampp.org.
23. ANSI - American National Standards Institute; www.ansi.org.
24. AOSA/SCST - Association of Official Seed Analysts (The)/Society of Commercial Seed Technologists (The); www.analyzeseeds.com.
25. APA - APA - The Engineered Wood Association; www.apawood.org.
26. APA - Architectural Precast Association; www.archprecast.org.
27. API - American Petroleum Institute; www.api.org.
28. ARMA - Asphalt Roofing Manufacturers Association; www.asphaltroofing.org.
29. ASA - Acoustical Society of America; www.acousticalsociety.org.
30. ASCE - American Society of Civil Engineers; www.asce.org.
31. ASCE/SEI - American Society of Civil Engineers/Structural Engineering Institute; (see ASCE).
32. ASHRAE - American Society of Heating, Refrigerating and Air-Conditioning Engineers; www.ashrae.org.
33. ASME - ASME International; American Society of Mechanical Engineers (The); www.asme.org.
34. ASSE - ASSE International; (American Society of Sanitary Engineering); www.asse-plumbing.org.
35. ASSP - American Society of Safety Professionals; www.assp.org.
36. ASTM - ASTM International; www.astm.org.
37. ATIS - Alliance for Telecommunications Industry Solutions; www.atis.org.
38. AVIXA - Audiovisual and Integrated Experience Association; www.avixa.org.
39. AWI - Architectural Woodwork Institute; www.awinet.org.
40. AWMAC - Architectural Woodwork Manufacturers Association of Canada; www.awmac.com.
41. AWPA - American Wood Protection Association; www.awpa.com.
42. AWS - American Welding Society; www.aws.org.
43. AWWA - American Water Works Association; www.awwa.org.
44. BHMA - Builders Hardware Manufacturers Association; www.buildershardware.com.
45. BIA - Brick Industry Association (The); www.gobrick.com.
46. BICSI - BICSI, Inc.; www.bicsi.org.
47. BIFMA - Business and Institutional Furniture Manufacturer's Association; www.bifma.org.
48. BISSC - Baking Industry Sanitation Standards Committee; www.bissc.org.
49. BSI - British Standards Institution; www.bsigroup.com.
50. BWF - Badminton World Federation; www.bwfbadminton.com.
51. CARB - California Air Resources Board; www.arb.ca.gov.
52. CDA - Copper Development Association Inc.; www.copper.org.

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53. CE - Conformite Europeenne (European Commission); www.ec.europa.eu/growth/single-market/ce-marking.
54. CEA - Canadian Electricity Association; www.electricity.ca.
55. CFFA - Chemical Fabrics and Film Association, Inc.; www.chemicalfabricsandfilm.com.
56. CFSEI - Cold-Formed Steel Engineers Institute; www.cfsei.org.
57. CGA - Compressed Gas Association; www.cganet.com.
58. CIMA - Cellulose Insulation Manufacturers Association; www.cellulose.org.
59. CISCA - Ceilings & Interior Systems Construction Association; www.cisca.org.
60. CISPI - Cast Iron Soil Pipe Institute; www.cispi.org.
61. CLFMI - Chain Link Fence Manufacturers Institute; www.chainlinkinfo.org.
62. CMHA - Concrete Masonry & Hardscape Association; (Formerly: National Concrete Masonry Association); www.masonryandhardscapes.org.
63. CPA - Composite Panel Association; www.compositepanel.org.
64. CRI - Carpet and Rug Institute (The); www.carpet-rug.org.
65. CRRC - Cool Roof Rating Council; www.coolroofs.org.
66. CRSI - Concrete Reinforcing Steel Institute; www.crsi.org.
67. CSA - CSA Group; www.csagroup.org.
68. CSI - Cast Stone Institute; www.caststone.org.
69. CSI - Construction Specifications Institute (The); www.csiresources.org.
70. CSSB - Cedar Shake & Shingle Bureau; www.cedarbureau.org.
71. CTA - Consumer Technology Association; www.cta.tech.
72. CTI - Cooling Technology Institute; www.coolingtechnology.org.
73. DASMA - Door and Access Systems Manufacturers Association; www.dasma.com.
74. DHA - Decorative Hardwoods Association; www.decorativehardwoods.org.
75. DHI - Door and Hardware Institute; www.dhi.org.
76. ECIA - Electronic Components Industry Association; www.ecianow.org.
77. EIMA - EIFS Industry Members Association; www.eima.com.
78. EJMA - Expansion Joint Manufacturers Association, Inc.; www.ejma.org.
79. EOS/ESD - EOS/ESD Association, Inc.; Electrostatic Discharge Association; www.esda.org.
80. ESTA - Entertainment Services and Technology Association; www.esta.org.
81. EVO - Efficiency Valuation Organization; www.evo-world.org.
82. FCI - Fluid Controls Institute; www.fluidcontrolsinstitute.org.
83. FGIA - Fenestration and Glazing Industry Alliance; https://fgiaonline.org.
84. FIBA - Federation Internationale de Basketball; (The International Basketball Federation); www.fiba.com.
85. FIVB - Federation Internationale de Volleyball; (The International Volleyball Federation); www.fivb.org.
86. FM Approvals - FM Approvals LLC; www.fmapprovals.com.
87. FM Global - FM Global; www.fmglobal.com.
88. FRSA - Florida Roofing and Sheet Metal Contractors Association, Inc.; www.floridaroof.com.
89. FSA - Fluid Sealing Association; www.fluidsealing.com.
90. FSC - Forest Stewardship Council U.S.; www.fscus.org.
91. GA - Gypsum Association; www.gypsum.org.
92. GS - Green Seal; www.greenseal.org.
93. HI - Hydraulic Institute; www.pumps.org.
94. HMMA - Hollow Metal Manufacturers Association; (see NAAMM).
95. IAPSC - International Association of Professional Security Consultants; www.iapsc.org.
96. IAS - International Accreditation Service; www.iasonline.org.
97. ICC - International Code Council; www.iccsafe.org.
98. ICEA - Insulated Cable Engineers Association, Inc.; www.icea.net.
99. ICPA - International Cast Polymer Association (The); www.theicpa.com.
100. ICRI - International Concrete Repair Institute, Inc.; www.icri.org.
101. IEC - International Electrotechnical Commission; www.iec.ch.
102. IEEE SA - IEEE Standards Association; https://standards.ieee.org.
103. IES - Illuminating Engineering Society; www.ies.org.
104. IEST - Institute of Environmental Sciences and Technology; www.iest.org.
105. IGMA - Insulating Glass Manufacturers Alliance; (see FGIA).
106. IGSHPA - International Ground Source Heat Pump Association; www.igshpa.org.
107. ILI - Indiana Limestone Institute of America, Inc.; www.iliai.com.
108. Intertek - Intertek Group; www.intertek.com.
109. ISA - International Society of Automation (The); www.isa.org.
110. ISFA - International Surface Fabricators Association; www.isfanow.org.

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111. ISO - International Organization for Standardization; www.iso.org.
112. ITU - International Telecommunication Union; www.itu.int.
113. KCMA - Kitchen Cabinet Manufacturers Association; www.kcma.org.
114. LPI - Lightning Protection Institute; www.lightning.org.
115. MBMA - Metal Building Manufacturers Association; www.mbma.com.
116. MCA - Metal Construction Association; www.metalconstruction.org.
117. MFMA - Maple Flooring Manufacturers Association, Inc.; www.maplefloor.org.
118. MFMA - Metal Framing Manufacturers Association, Inc.; www.metalframingmfg.org.
119. MHI - Material Handling Industry; www.mhi.org.
120. MMPA - Moulding & Millwork Producers Association; www.wmmpa.com.
121. MPI - Master Painters Institute; www.paintinfo.com.
122. MSS - Manufacturers Standardization Society of The Valve and Fittings Industry, Inc.; www.msshq.org.
123. NAAMM - National Association of Architectural Metal Manufacturers; www.naamm.org.
124. NACE - NACE International; (National Association of Corrosion Engineers International); (see AMPP).
125. NADCA - National Air Duct Cleaners Association; www.nadca.com.
126. NAIMA - North American Insulation Manufacturers Association; www.insulationinstitute.org.
127. NALP - National Association of Landscape Professionals; www.landscapeprofessionals.org.
128. NBGQA - National Building Granite Quarries Association, Inc.; www.nbgqa.com.
129. NBI - New Buildings Institute; www.newbuildings.org.
130. NCAA - National Collegiate Athletic Association (The); www.ncaa.org.
131. NCMA - National Concrete Masonry Association; (see CMHA).
132. NEBB - National Environmental Balancing Bureau; www.nebb.org.
133. NECA - National Electrical Contractors Association; www.necanet.org.
134. NeLMA - Northeastern Lumber Manufacturers Association; www.nelma.org.
135. NEMA - National Electrical Manufacturers Association; www.nema.org.
136. NETA - InterNational Electrical Testing Association; www.netaworld.org.
137. NFHS - National Federation of State High School Associations; www.nfhs.org.
138. NFPA - National Fire Protection Association; www.nfpa.org.
139. NFPA - NFPA International; (see NFPA).
140. NFRC - National Fenestration Rating Council; www.nfrc.org.
141. NGA - National Glass Association; www.glass.org.
142. NHLA - National Hardwood Lumber Association; www.nhla.com.
143. NLGA - National Lumber Grades Authority; www.nlga.org.
144. NOFMA - National Oak Flooring Manufacturers Association; (see NWFA).
145. NOMMA - National Ornamental & Miscellaneous Metals Association; www.nomma.org.
146. NRCA - National Roofing Contractors Association; www.nrca.net.
147. NRMCA - National Ready Mixed Concrete Association; www.nrmca.org.
148. NSF - NSF International; www.nsf.org.
149. NSI - Natural Stone Institute; www.naturalstoneinstitute.org.
150. NSPE - National Society of Professional Engineers; www.nspe.org.
151. NSSGA - National Stone, Sand & Gravel Association; www.nssga.org.
152. NTMA - National Terrazzo & Mosaic Association, Inc. (The); www.ntma.com.
153. NWFA - National Wood Flooring Association; www.nwfa.org.
154. NWRA - National Waste & Recycling Association; www.wasterecycling.org.
155. PCI - Precast/Prestressed Concrete Institute; www.pci.org.
156. PDI - Plumbing & Drainage Institute; www.pdionline.org.
157. PLASA - PLASA; www.plasa.org.
158. PLIB - Pacific Lumber Inspection Bureau; www.plib.org.
159. PVCPA - Uni-Bell PVC Pipe Association; www.uni-bell.org.
160. RCSC - Research Council on Structural Connections; www.boltcouncil.org.
161. RFCI - Resilient Floor Covering Institute; www.rfci.com.
162. RIS - Redwood Inspection Service; (see WWPA).
163. SAE - SAE International; www.sae.org.
164. SCTE - Society of Cable Telecommunications Engineers; www.scte.org.
165. SDI - Steel Deck Institute; www.sdi.org.
166. SDI - Steel Door Institute; www.steeldoor.org.
167. SEFA - Scientific Equipment and Furniture Association (The); www.sefalabs.com.
168. SEI/ASCE - Structural Engineering Institute/American Society of Civil Engineers; (see ASCE).
169. SIA - Security Industry Association; www.securityindustry.org.
170. SJI - Steel Joist Institute; www.steeljoist.org.

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171. SMA - Screen Manufacturers Association; www.smainfo.org.
172. SMACNA - Sheet Metal and Air Conditioning Contractors' National Association; www.smacna.org.
173. SMPTE - Society of Motion Picture and Television Engineers; www.smpte.org.
174. SPFA - Spray Polyurethane Foam Alliance; www.sprayfoam.org.
175. SPIB - Southern Pine Inspection Bureau; www.spib.org.
176. SPRI - Single Ply Roofing Industry; www.spri.org.
177. SRCC - Solar Rating & Certification Corporation; www.solar-rating.org.
178. SSINA - Specialty Steel Industry of North America; www.ssina.com.
179. SSPC - SSPC: The Society for Protective Coatings; (see AMPP).
180. STI/SPFA - Steel Tank Institute/Steel Plate Fabricators Association; www.steeltank.com.
181. SWI - Steel Window Institute; www.steelwindows.com.
182. SWPA - Submersible Wastewater Pump Association; www.swpa.org.
183. TCA - Tilt-Up Concrete Association; www.tilt-up.org.
184. TCNA - Tile Council of North America, Inc.; www.tcnatile.com.
185. TEMA - Tubular Exchanger Manufacturers Association, Inc.; www.kbcdco.tema.org.
186. TIA - Telecommunications Industry Association; www.tiaonline.org.
187. TMS - The Masonry Society; www.masonrysociety.org.
188. TPI - Truss Plate Institute; www.tpinst.org.
189. TPI - Turfgrass Producers International; www.turfgrasssod.org.
190. TRI - Tile Roofing Industry Alliance; www.tileroofing.org.
191. ULSE - UL Standards & Engagement Inc.; www.ulse.org.
192. UL - UL Solutions Inc.; www.ul.com.
193. USAV - USA Volleyball; www.usavolleyball.org.
194. USGBC - U.S. Green Building Council; www.usgbc.org.
195. USITT - United States Institute for Theatre Technology, Inc.; www.usitt.org.
196. WA - Wallcoverings Association; www.wallcoverings.org.
197. WCLIB - West Coast Lumber Inspection Bureau; (see PLIB).
198. WCMA - Window Covering Manufacturers Association; www.wcmanet.org.
199. WDMA - Window & Door Manufacturers Association; www.wdma.com.
200. WI - Woodwork Institute; www.woodworkinstitute.com.
201. WSRCA - Western States Roofing Contractors Association; www.wsrca.com.
202. WWPA - Western Wood Products Association; www.wwpa.org.

C. Code Agencies: Where abbreviations and acronyms are used in Specifications or other Contract Documents, they are to mean the recognized name of the entities in the following list. This information is believed to be accurate as of the date of the Contract Documents.

1. DIN - Deutsches Institut fur Normung e.V.; www.din.de.
2. IAPMO - International Association of Plumbing and Mechanical Officials; www.iapmo.org.
3. ICC - International Code Council; www.iccsafe.org.
4. ICC-ES - ICC Evaluation Service, LLC; www.icc-es.org.

D. Federal Government Agencies: Where abbreviations and acronyms are used in Specifications or other Contract Documents, they are to mean the recognized name of the entities in the following list. Information is subject to change and is up to date as of the date of the Contract Documents.

1. CPSC - U.S. Consumer Product Safety Commission; www.cpsc.gov.
2. DOC - U.S. Department of Commerce; www.commerce.gov.
3. DOD - U.S. Department of Defense; www.defense.gov.
4. DOE - U.S. Department of Energy; www.energy.gov.
5. DOJ - U.S. Department of Justice; www.ojp.usdoj.gov
6. DOS - U.S. Department of State; www.state.gov.
7. EPA - United States Environmental Protection Agency; www.epa.gov.
8. FAA - Federal Aviation Administration; www.faa.gov.
9. GPO - U.S. Government Publishing Office; www.gpo.gov.
10. GSA - U.S. General Services Administration; www.gsa.gov.
11. HUD - U.S. Department of Housing and Urban Development; www.hud.gov.
12. LBNL - Lawrence Berkeley National Laboratory; Energy Technologies Area; www.lbl.gov/.
13. NIST - National Institute of Standards and Technology; www.nist.gov.
14. OSHA - Occupational Safety & Health Administration; www.osha.gov.
15. TRB - Transportation Research Board; National Cooperative Highway Research Program; The National Academies; www.trb.org.

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16. USACE - U.S. Army Corps of Engineers; www.usace.army.mil.
17. USDA - U.S. Department of Agriculture; Agriculture Research Service; U.S. Salinity Laboratory; www.ars.usda.gov.
18. USDA - U.S. Department of Agriculture; Rural Utilities Service; www.usda.gov.
19. USP - U.S. Pharmacopeial Convention; www.usp.org.
20. USPS - United States Postal Service; www.usps.com.

E. Standards and Regulations: Where abbreviations and acronyms are used in Specifications or other Contract Documents, they are to mean the recognized name of the standards and regulations in the following list. This information is subject to change and is believed to be accurate as of the date of the Contract Documents.

1. CFR - Code of Federal Regulations; Available from U.S. Government Publishing Office; www.govinfo.gov.
2. DOD - U.S. Department of Defense; Military Specifications and Standards; Available from DLA Document Services; www.dsp.dla.mil/Specs-Standards/.
3. DSCC - Defense Supply Center Columbus; (see FS).
4. FED-STD - Federal Standard; (see FS).
5. FS - Federal Specification; Available from DLA Document Services; www.dsp.dla.mil/Specs-Standards/.

    a. Available from Defense Standardization Program; www.dsp.dla.mil.
    b. Available from U.S. General Services Administration; www.gsa.gov.
    c. Available from National Institute of Building Sciences/Whole Building Design Guide; www.wbdg.org.

6. MILSPEC - Military Specifications and Standards; (see DOD).
7. USAB - United States Access Board; www.access-board.gov.
8. USATBCB - U.S. Architectural & Transportation Barriers Compliance Board; (see USAB).

F. State Government Agencies: Where abbreviations and acronyms are used in Specifications or other Contract Documents, they are to mean the recognized name of the entities in the following list. This information is subject to change and is believed to be accurate as of the date of the Contract Documents.

1. BEARHFTI; California Bureau of Electronic and Appliance Repair, Home Furnishings and Thermal Insulation; (see BHGS).
2. BHGS; State of California Bureau of Household Goods and Services; (Formerly: California Bureau of Electronic and Appliance Repair, Home Furnishings and Thermal Insulation); www.bhgs.dca.ca.gov.
3. CCR; California Code of Regulations; Office of Administrative Law; California Title 24 Energy Code; www.oal.ca.gov/publications/ccr/.
4. CDPH; California Department of Public Health; Indoor Air Quality Program; www.cdph.ca.gov/Programs/CCDPHP/DEODC/EHLB/IAQ/Pages/Main-Page.aspx.
5. CPUC; California Public Utilities Commission; www.cpuc.ca.gov.
6. SCAQMD; South Coast Air Quality Management District; www.aqmd.gov.
7. TFS; Texas A&M Forest Service; Sustainable Forestry and Economic Development; https://tfsweb.tamu.edu/.

PART 2 - PRODUCTS (Not Used)
PART 3 - EXECUTION (Not Used)

END OF SECTION 01 42 00

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SECTION 01 50 00 - TEMPORARY FACILITIES AND CONTROLS

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes requirements for temporary utilities, support facilities, and security and protection facilities.

B. Related Requirements:

1. Section 011000 "Summary" for work restrictions and limitations on utility interruptions.
2. Section 012100 "Allowances" for allowance for metered use of temporary utilities.

1.2 USE CHARGES

A. Installation, removal, and use charges for temporary facilities to be included in the Contract Sum unless otherwise indicated. Allow other entities engaged in the Project to use temporary services and facilities without cost, including, but not limited to, Architect, testing agencies, and authorities having jurisdiction.

B. Sewer Service: Pay sewer-service use charges for sewer usage by all entities for construction operations.

C. Water Service: Pay water-service use charges for water used by all entities for construction operations.

D. Electric Power Service: Pay electric-power-service use charges for electricity used by all entities for construction operations.

E. Water and Sewer Service from Existing System: Water from Owner's existing water system is available for use without metering and without payment of use charges . Provide connections and extensions of services as required for construction operations.

F. Electric Power Service from Existing System: Electric power from Owner's existing system is available for use without metering and without payment of use charges . Provide connections and extensions of services as required for construction operations.

G. Sewer, Water, and Electric Power Service: Use charges are specified in Section 011200 "Multiple Contract Summary."

1.3 INFORMATIONAL SUBMITTALS

A. Site Utilization Plan: Show temporary facilities, temporary utility lines and connections, staging areas, construction site entrances, vehicle circulation, and parking areas for construction personnel.

B. Implementation and Termination Schedule: Within 15 days of date established for commencement of the Work, submit schedule indicating implementation and termination dates of each temporary utility.

C. Project Identification and Temporary Signs: Show fabrication and installation details, including plans, elevations, details, layouts, typestyles, graphic elements, and message content.

D. Fire-Safety Program: Show compliance with requirements of NFPA 241 and authorities having jurisdiction. Indicate Contractor personnel responsible for management of fire-prevention program.

E. Moisture- and Mold-Protection Plan: Describe procedures and controls for protecting materials and construction from water absorption and damage and mold. Describe delivery, handling, storage, installation, and protection provisions for materials subject to water absorption or water damage.

1. Indicate procedures for discarding water-damaged materials, protocols for mitigating water intrusion into completed Work, and requirements for replacing water-damaged Work.
2. Indicate sequencing of work that requires water, such as sprayed fire-resistive materials,

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plastering, and terrazzo grinding, and describe plans for dealing with water from these operations. Show procedures for verifying that wet construction has dried sufficiently to permit installation of finish materials.

3. Indicate methods to be used to avoid trapping water in finished work.

F. Dust- and HVAC-Control Plan: Submit coordination drawing and narrative that indicates the dust- and HVAC-control measures proposed for use, proposed locations, and proposed time frame for their operation. Include the following:

1. Locations of dust-control partitions at each phase of work.
2. HVAC system isolation schematic drawing.
3. Location of proposed air-filtration system discharge.
4. Waste-handling procedures.
5. Other dust-control measures.

G. Noise and Vibration Control Plan: Identify construction activities that may impact the occupancy and use of existing spaces within the building or adjacent existing buildings, whether occupied by others, or occupied by Owner. Include the following:

1. Methods used to meet the goals and requirements of Owner.
2. Concrete cutting method(s) to be used.
3. Location of construction devices on the site.
4. Show compliance with the use and maintenance of quieted construction devices for the duration of the Project.
5. Indicate activities that may disturb building occupants and that are planned to be performed during non-standard working hours as coordinated with Owner.
6. Indicate locations of sensitive areas or other areas requiring special attention as identified by Owner. Indicate means for complying with Owner's requirements.

1.4 QUALITY ASSURANCE

A. Electric Service: Comply with NECA, NEMA, and UL standards and regulations for temporary electric service. Install service to comply with NFPA 70.

B. Tests and Inspections: Arrange for authorities having jurisdiction to test and inspect each temporary utility before use. Obtain required certifications and permits.

C. Accessible Temporary Egress: Comply with applicable provisions in ICC A117.1 .

1.5 PROJECT CONDITIONS

A. Temporary Use of Permanent Facilities: Engage Installer of each permanent service to assume responsibility for operation, maintenance, and protection of each permanent service during its use as a construction facility before Owner's acceptance, regardless of previously assigned responsibilities.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Chain-Link Fencing: Minimum **2-inch**, **0.148-inch-** thick, galvanized-steel, chain-link fabric fencing; minimum **6 feet** high with galvanized-steel pipe posts; minimum **2-3/8-inch-** OD line posts and **2-7/8-inch-** OD corner and pull posts .

B. Portable Chain-Link Fencing: Minimum **2-inch**, **0.148-inch-** thick, galvanized-steel, chain-link fabric fencing; minimum **6 feet** high with galvanized-steel pipe posts; minimum **2-3/8-inch-** OD line posts and **2-7/8-inch-** OD corner and pull posts, with **1-5/8-inch-** OD top and bottom rails. Provide galvanized-steel bases for supporting posts.

C. Fencing Windscreen Privacy Screen: Polyester fabric scrim with grommets for attachment to chain-link fence, sized to height of fence, in color selected by Architect from manufacturer's standard colors.

D. Wood Enclosure Fence: Plywood, 6 feet high, framed with four **2-by-4-inch** rails, with preservative-treated wood posts spaced not more than **8 feet** apart.

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E. Polyethylene Sheet: Reinforced, fire-resistive sheet, **10-mil** minimum thickness, with flame-spread rating of 15 or less in accordance with ASTM E84 and passing NFPA 701 Test Method 2.

F. Dust-Control Adhesive-Surface Walk-Off Mats: Provide mats, minimum **36 by 60 inches**.

G. Insulation: Unfaced mineral-fiber blanket, manufactured from glass, slag wool, or rock wool; with maximum flame-spread and smoke-developed indexes of 25 and 50, respectively.

2.2 TEMPORARY FACILITIES

A. Field Offices:

1. Prefabricated or mobile units with serviceable finishes, temperature controls, and foundations adequate for normal loading.

B. Common-Use Field Office: Of sufficient size to accommodate needs of Owner, Architect , and construction personnel office activities and to accommodate Project meetings specified in other Division 01 Sections. Keep office clean and orderly. Furnish and equip offices as follows:

1. Furniture required for Project-site documents, including file cabinets, plan tables, plan racks, and bookcases.
2. Conference room of sufficient size to accommodate meetings of 10 individuals. Provide electrical power service and 120-V ac duplex receptacles, with no fewer than one receptacle on each wall. Furnish room with conference table, chairs, and **4-foot-** square tack and marker boards.
3. Heating and cooling equipment necessary to maintain a uniform indoor temperature of **68 to 72 deg F**.
4. Lighting fixtures capable of maintaining average illumination of **20 fc** at desk height.

C. Storage and Fabrication Sheds: Provide sheds sized, furnished, and equipped to accommodate materials and equipment for construction operations.

1. Store combustible materials apart from building.

2.3 EQUIPMENT

A. Fire Extinguishers: Portable, UL rated; with class and extinguishing agent as required by locations and classes of fire exposures.

B. HVAC Equipment: Unless Owner authorizes use of permanent HVAC system, provide vented, self-contained, liquid-propane-gas or fuel-oil heaters with individual space thermostatic control.

1. Use of gasoline-burning space heaters, open-flame heaters, or salamander-type heating units is prohibited.
2. Heating, Cooling, and Dehumidifying Units: Listed and labeled for type of fuel being consumed, by a qualified testing agency acceptable to authorities having jurisdiction, and marked for intended location and application.

C. Air-Filtration Units: Primary and secondary HEPA-filter-equipped portable units with four-stage filtration. Provide single switch for emergency shutoff. Configure to run continuously.

PART 3 - EXECUTION

3.1 TEMPORARY FACILITIES, GENERAL

A. Conservation: Coordinate construction and use of temporary facilities with consideration given to conservation of energy, water, and materials. Coordinate use of temporary utilities to minimize waste.

1. Salvage materials and equipment involved in performance of, but not actually incorporated into, the Work. See other Sections for disposition of salvaged materials that are designated as Owner's property.

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3.2 INSTALLATION, GENERAL

A. Locate facilities where they will serve Project adequately and result in minimum interference with performance of the Work. Relocate and modify facilities as required by progress of the Work.

1. Locate facilities to limit site disturbance as specified in Section 011000 "Summary."

B. Provide each facility ready for use when needed to avoid delay. Do not remove until facilities are no longer needed or are replaced by authorized use of completed permanent facilities.

C. Isolation of Work Areas in Occupied Facilities: Prevent dust, fumes, and odors from entering occupied areas.

1. Prior to commencing work, isolate the HVAC system in area where work is to be performed .

a. Disconnect supply and return ductwork in work area from HVAC systems servicing occupied areas.
b. Maintain negative air pressure within work area, using HEPA-equipped air-filtration units, starting with commencement of temporary partition construction, and continuing until removal of temporary partitions is complete.

2. Maintain dust partitions during the Work. Use vacuum collection attachments on dust-producing equipment. Isolate limited work within occupied areas using portable dust-containment devices.
3. Perform daily construction cleanup and final cleanup using approved, HEPA-filter-equipped vacuum equipment.

3.3 TEMPORARY UTILITY INSTALLATION

A. General: Install temporary service or connect to existing service.

1. Arrange with utility company, Owner, and existing users for time when service can be interrupted, if necessary, to make connections for temporary services.

B. Sewers and Drainage: Provide temporary utilities to remove effluent lawfully.

1. Connect temporary sewers to municipal system as directed by authorities having jurisdiction.

C. Water Service:

1. Install water service and distribution piping in sizes and pressures adequate for construction.
2. Connect to Owner's existing water service facilities. Clean and maintain water service facilities in a condition acceptable to Owner. At Substantial Completion, restore these facilities to condition existing before initial use.

D. Sanitary Facilities: Provide temporary toilets, wash facilities, safety shower and eyewash facilities, and drinking water for use of construction personnel. Comply with requirements of authorities having jurisdiction for type, number, location, operation, and maintenance of fixtures and facilities.

1. Use of Permanent Toilets: Use of Owner's existing or new toilet facilities will be permitted, as long as facilities are cleaned and maintained in a condition acceptable to Owner. At Substantial Completion, restore these facilities to condition existing before initial use .

E. Temporary Heating and Cooling: Provide temporary heating and cooling required by construction activities for curing or drying of completed installations or for protecting installed construction from adverse effects of low temperatures or high humidity. Select equipment that will not have a harmful effect on completed installations or elements being installed.

1. Provide temporary dehumidification systems when required to reduce ambient and substrate moisture levels to level required to allow installation or application of finishes and their proper curing or drying.

F. Electric Power Service:

1. Connect to Owner's existing electric power service. Maintain equipment in a condition acceptable to Owner.

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2. Provide electric power service and distribution system of sufficient size, capacity, and power characteristics required for construction operations.

    a. Install electric power service overhead unless otherwise indicated.
    b. Connect temporary service to Owner's existing power source, as directed by Owner.

G. Lighting: Provide temporary lighting with local switching that provides adequate illumination for construction operations, observations, inspections, and traffic conditions.

1. Install and operate temporary lighting that fulfills security and protection requirements without operating entire system.

H. Telephone Service: Provide temporary telephone service in common-use facilities for use by all construction personnel. Install WiFi cell phone access equipment land-based telephone line(s) for each field office.

1. At each telephone, post a list of important telephone numbers.

    a. Police and fire departments.
    b. Ambulance service.
    c. Contractor's home office.
    d. Contractor's emergency after-hours telephone number.
    e. Architect's office.
    f. Engineers' offices.
    g. Owner's office.
    h. Principal subcontractors' field and home offices.

I. Electronic Communication Service: Provide secure WiFi wireless connection to internet with provisions for access by Architect and Owner.

3.4 SUPPORT FACILITIES INSTALLATION

A. Comply with the following:

1. Provide construction for temporary field offices, shops, and sheds located within construction area or within **30 feet** of building lines that is noncombustible in accordance with ASTM E136. Comply with NFPA 241.
2. Utilize designated area within existing building for temporary field offices.
3. Maintain support facilities until Architect schedules Substantial Completion inspection. Remove before Substantial Completion. Personnel remaining after Substantial Completion will be permitted to use permanent facilities, under conditions acceptable to Owner.

B. Temporary Roads and Paved Areas: Construct and maintain temporary roads and paved areas adequate for construction operations. Locate temporary roads and paved areas within construction limits indicated on Drawings.

1. Provide dust-control treatment that is nonpolluting and nontracking. Reapply treatment as required to minimize dust.

C. Temporary Use of Planned Permanent Roads and Paved Areas: Locate temporary roads and paved areas in same location as permanent roads and paved areas. Construct and maintain temporary roads and paved areas adequate for construction operations. Extend temporary roads and paved areas, within construction limits indicated, as necessary for construction operations.

1. Coordinate elevations of temporary roads and paved areas with permanent roads and paved areas.
2. Prepare subgrade and install subbase and base for temporary roads and paved areas in accordance with Section 312000 "Earth Moving."
3. Recondition base after temporary use, including removing contaminated material, regrading, proofrolling, compacting, and testing.
4. Delay installation of final course of permanent hot-mix asphalt pavement until immediately before Substantial Completion. Repair hot-mix asphalt base-course pavement before installation of final course in accordance with Section 321216 "Asphalt Paving."

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D. Traffic Controls: Comply with requirements of authorities having jurisdiction.

1. Protect existing site improvements to remain, including curbs, pavement, and utilities.
2. Maintain access for fire-fighting equipment and access to fire hydrants.

E. Parking: Provide temporary offsite parking areas for construction personnel.

F. Storage and Staging: Use designated areas of Project site for storage and staging needs.

G. Dewatering Facilities and Drains: Comply with requirements of authorities having jurisdiction. Maintain Project site, excavations, and construction free of water.

1. Dispose of rainwater in a lawful manner that will not result in flooding Project or adjoining properties or endanger permanent Work or temporary facilities.
2. Remove snow and ice as required to minimize accumulations.

H. Project Signs: Provide Project signs as indicated. Unauthorized signs are not permitted.

1. Identification Signs: Provide Project identification signs as indicated on Drawings.
2. Temporary Signs: Provide other signs as indicated and as required to inform public and individuals seeking entrance to Project.

   a. Provide temporary, directional signs for construction personnel and visitors.

3. Maintain and touch up signs, so they are legible at all times.

I. Waste Disposal Facilities:

1. Comply with requirements specified in Section 017419 "Construction Waste Management and Disposal."
2. Provide waste-collection containers in sizes adequate to handle waste from construction operations. Comply with requirements of authorities having jurisdiction. Comply with progress cleaning requirements in Section 017300 "Execution."

J. Lifts and Hoists: Provide facilities necessary for hoisting materials and personnel.

1. Truck cranes and similar devices used for hoisting materials are considered "tools and equipment" and not temporary facilities.

K. Existing Elevator Use: Use of Owner's existing elevators will be permitted, provided elevators are cleaned and maintained in a condition acceptable to Owner. At Substantial Completion, restore elevators to condition existing before initial use, including replacing worn cables, guide shoes, and similar items of limited life.

1. Do not load elevators beyond their rated weight capacity.
2. Provide protective coverings, barriers, devices, signs, or other procedures to protect elevator car and entrance doors and frame. If, despite such protection, elevators become damaged, engage elevator Installer to restore damaged work, so no evidence remains of correction work. Return items that cannot be refinished in field to the shop, make required repairs and refinish entire unit, or provide new units as required.

L. Temporary Stairs: Until permanent stairs are available, provide temporary stairs where ladders are not adequate.

M. Existing Stair Usage: Use of Owner's existing stairs will be permitted, provided stairs are cleaned and maintained in a condition acceptable to Owner. At Substantial Completion, restore stairs to condition existing before initial use.

1. Provide protective coverings, barriers, devices, signs, or other procedures to protect stairs and to maintain means of egress. If stairs become damaged, restore damaged areas, so no evidence remains of correction work.

N. Temporary Use of Permanent Stairs: Use of new stairs for construction traffic will be permitted, provided stairs are protected and finishes restored to new condition at time of Substantial Completion.

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3.5 SECURITY AND PROTECTION FACILITIES INSTALLATION

A. Protection of Existing Facilities: Protect existing vegetation, equipment, structures, utilities, and other improvements at Project site and on adjacent properties, except those indicated to be removed or altered. Repair damage to existing facilities.

1. Where access to adjacent properties is required in order to affect protection of existing facilities, obtain written permission from adjacent property owner to access property for that purpose.

B. Environmental Protection: Provide protection, operate temporary facilities, and conduct construction as required to comply with environmental regulations and that minimize possible air, waterway, and subsoil contamination or pollution or other undesirable effects.

1. Comply with work restrictions specified in Section 011000 "Summary."

C. Temporary Erosion and Sedimentation Control:

D. Stormwater Control: Comply with requirements of authorities having jurisdiction. Provide barriers in and around excavations and subgrade construction to prevent flooding by runoff of stormwater from heavy rains.

E. Tree and Plant Protection:

1. Comply with requirements specified in Section 015639 "Temporary Tree and Plant Protection."
2. Install temporary fencing located as indicated or outside the drip line of trees to protect vegetation from damage from construction operations. Protect tree root systems from damage, flooding, and erosion.

F. Pest Control: Engage pest-control service to recommend practices to minimize attraction and harboring of rodents, roaches, and other pests and to perform extermination and control procedures at regular intervals, so Project will be free of pests and their residues at Substantial Completion. Perform control operations lawfully, using materials approved by authorities having jurisdiction.

G. Site Enclosure Fence: Before construction operations begin , furnish and install site enclosure fence in a manner that will prevent people from easily entering site except by entrance gates.

1. Extent of Fence: As required to enclose entire Project site or portion determined sufficient to accommodate construction operations .
2. Maintain security by limiting number of keys and restricting distribution to authorized personnel.

H. Security Enclosure and Lockup: Install temporary enclosure around partially completed areas of construction. Provide lockable entrances to prevent unauthorized entrance, vandalism, theft, and similar violations of security. Lock entrances at end of each workday.

I. Barricades, Warning Signs, and Lights: Comply with requirements of authorities having jurisdiction for erecting structurally adequate barricades, including warning signs and lighting.

J. Temporary Egress: Provide temporary egress from existing occupied facilities as indicated and as required by authorities having jurisdiction. Provide signage directing occupants to temporary egress.

K. Covered Walkway: Erect protective, covered walkway for passage of individuals through or adjacent to Project site. Coordinate with entrance gates, other facilities, and obstructions. Comply with regulations of authorities having jurisdiction .

1. Provide overhead decking, protective enclosure walls, handrails, barricades, warning signs, exit signs, lights, safe and well-drained walkways, and similar provisions for protection and safe passage.
2. Paint and maintain appearance of walkway for duration of the Work.

L. Temporary Enclosures: Provide temporary enclosures for protection of construction, in progress and completed, from exposure, foul weather, other construction operations, and similar activities. Provide temporary weathertight enclosure for building exterior.

1. Where heating or cooling is needed and permanent enclosure is incomplete, insulate temporary enclosures.

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M. Temporary Partitions: Provide floor-to-ceiling dustproof partitions to limit dust and dirt migration and to separate areas occupied by Owner from fumes and noise.

1. Construct dustproof partitions with gypsum wallboard, with joints taped on occupied side, and fire-retardant-treated plywood on construction operations side.
2. Construct dustproof partitions with two layers of **6-mil** polyethylene sheet on each side. Cover floor with two layers of **6-mil** polyethylene sheet, extending sheets **18 inches** up the sidewalls. Overlap and tape full length of joints. Cover floor with fire-retardant-treated plywood.

    a. Construct vestibule and airlock at each entrance through temporary partition with not less than **48 inches** between doors. Maintain water-dampened foot mats in vestibule.

3. Where fire-resistance-rated temporary partitions are indicated or are required by authorities having jurisdiction, construct partitions according to the rated assemblies.
4. Insulate partitions to control noise transmission to occupied areas.
5. Seal joints and perimeter. Equip partitions with gasketed dustproof doors and security locks where openings are required.
6. Protect air-handling equipment.
7. Provide walk-off mats at each entrance through temporary partition.

N. Temporary Fire Protection: Install and maintain temporary fire-protection facilities of types needed to protect against reasonably predictable and controllable fire losses. Comply with NFPA 241; manage fire-prevention program.

1. Prohibit smoking in construction areas. Comply with additional limits on smoking specified in other Sections.
2. Supervise welding operations, combustion-type temporary heating units, and similar sources of fire ignition in accordance with requirements of authorities having jurisdiction.
3. Develop and supervise an overall fire-prevention and -protection program for personnel at Project site. Review needs with local fire department and establish procedures to be followed. Instruct personnel in methods and procedures. Post warnings and information.
4. Provide temporary standpipes and hoses for fire protection. Hang hoses with a warning sign, stating that hoses are for fire-protection purposes only and are not to be removed. Match hose size with outlet size and equip with suitable nozzles.

3.6 MOISTURE AND MOLD CONTROL

A. Moisture and Mold Protection: Protect stored materials and installed Work in accordance with Moisture and Mold Protection Plan.

B. Exposed Construction Period: Before installation of weather barriers, when materials are subject to wetting and exposure and to airborne mold spores, protect as follows:

1. Protect porous materials from water damage.
2. Protect stored and installed material from flowing or standing water.
3. Keep porous and organic materials from coming into prolonged contact with concrete.
4. Remove standing water from decks.
5. Keep deck openings covered or dammed.

C. Partially Enclosed Construction Period: After installation of weather barriers but before full enclosure and conditioning of building, when installed materials are still subject to infiltration of moisture and ambient mold spores, protect as follows:

1. Do not load or install drywall or other porous materials or components, or items with high organic content, into partially enclosed building.
2. Keep interior spaces reasonably clean and protected from water damage.
3. Periodically collect and remove waste containing cellulose or other organic matter.
4. Discard or replace water-damaged material.
5. Do not install material that is wet.
6. Discard and replace stored or installed material that begins to grow mold.
7. Perform work in a sequence that allows wet materials adequate time to dry before enclosing the material in gypsum board or other interior finishes.

D. Controlled Construction Period: After completing and sealing of the building enclosure but prior to the

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full operation of permanent HVAC systems, maintain as follows:

1. Control moisture and humidity inside building by maintaining effective dry-in conditions.
2. Use temporary or permanent HVAC system to control humidity within ranges specified for installed and stored materials.
3. Comply with manufacturer's written instructions for temperature, relative humidity, and exposure to water limits.

    a. Hygroscopic materials that may support mold growth, including wood and gypsum-based products, that become wet during the course of construction and remain wet for 48 hours are considered defective and require replacing.
    b. Measure moisture content of materials that have been exposed to moisture during construction operations or after installation. Record readings beginning at time of exposure and continuing daily for 48 hours. Identify materials containing moisture levels higher than allowed. Report findings in writing to Architect.
    c. Remove and replace materials that cannot be completely restored to their manufactured moisture level within 48 hours.

3.7 OPERATION, TERMINATION, AND REMOVAL

A. Supervision: Enforce strict discipline in use of temporary facilities. To minimize waste and abuse, limit availability of temporary facilities to essential and intended uses.

B. Maintenance: Maintain facilities in good operating condition until removal.

1. Maintain operation of temporary enclosures, heating, cooling, humidity control, ventilation, and similar facilities on a 24-hour basis where required to achieve indicated results and to avoid possibility of damage.

C. Temporary Facility Changeover: Do not change over from using temporary security and protection facilities to permanent facilities until Substantial Completion.

D. Termination and Removal: Remove each temporary facility when need for its service has ended, when it has been replaced by authorized use of a permanent facility, or no later than Substantial Completion. Complete or, if necessary, restore permanent construction that may have been delayed because of interference with temporary facility. Repair damaged Work, clean exposed surfaces, and replace construction that cannot be satisfactorily repaired.

1. Materials and facilities that constitute temporary facilities are property of Contractor. Owner reserves right to take possession of Project identification signs.
2. Remove temporary roads and paved areas not intended for or acceptable for integration into permanent construction. Where area is intended for landscape development, remove soil and aggregate fill that do not comply with requirements for fill or subsoil. Remove materials contaminated with road oil, asphalt and other petrochemical compounds, and other substances that might impair growth of plant materials or lawns. Repair or replace street paving, curbs, and sidewalks at temporary entrances, as required by authorities having jurisdiction.
3. At Substantial Completion, repair, renovate, and clean permanent facilities used during construction period. Comply with final cleaning requirements specified in Section 017700 "Closeout Procedures."

END OF SECTION 01 50 00

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SECTION 01 60 00 - PRODUCT REQUIREMENTS

PART 1 - GENERAL

1.1 SUMMARY

A. The Work of This Section Includes: Administrative and procedural requirements for selection of products for use in Project; product delivery, storage, and handling; manufacturers' standard warranties on products; special warranties; and comparable products.

B. Related Requirements:

1. Section 012100 "Allowances" for products selected under an allowance.
2. Section 012300 "Alternates" for products selected under an alternate.
3. Section 012500 "Substitution Procedures" for requests for substitutions.
4. Section 014200 "References" for applicable industry standards for products specified.
5. Section 017700 "Closeout Procedures" for submitting warranties.

1.2 DEFINITIONS

A. Products: Items obtained for incorporating into the Work, whether purchased for Project or taken from previously purchased stock. The term "product" includes the terms "material," "equipment," "system," and terms of similar intent.

1. Named Products: Items identified by manufacturer's product name, including make or model number or other designation shown or listed in manufacturer's published product literature that is current as of date of the Contract Documents.
2. New Products: Items that have not previously been incorporated into another project or facility. Salvaged items or items reused from other projects are not considered new products. Items that are manufactured or fabricated to include recycled content materials are considered new products unless otherwise indicated.
3. Comparable Product: Product by named manufacturer that is demonstrated and approved through the comparable product submittal process described in "Comparable Products" Article, to have the indicated qualities related to type, function, dimension, in-service performance, physical properties, appearance, and other characteristics that equal or exceed those of specified product.

B. Basis-of-Design Product Specification: A specification in which a single manufacturer's product is named and accompanied by the words "basis-of-design product," including make or model number or other designation. Published attributes and characteristics of basis-of-design product establish salient characteristics of products.

1. Evaluating Comparable Products: In addition to the basis-of-design product description, product attributes and characteristics may be listed to establish the significant qualities related to type, function, in-service performance and physical properties, weight, dimension, durability, visual characteristics, and other special features and requirements for purposes of evaluating comparable products of additional manufacturers named in the specification. Manufacturer's published attributes and characteristics of basis-of-design product also establish salient characteristics of products for purposes of evaluating comparable products.

C. Subject to Compliance with Requirements: Where the phrase "Subject to compliance with requirements" introduces a product selection procedure in an individual Specification Section, provide products qualified under the specified product procedure. In the event that a named product or product by a named manufacturer does not meet the other requirements of the specifications, select another named product or product from another named manufacturer that does meet the requirements of the specifications; submit a comparable product request or substitution request, if applicable.

D. Comparable Product Request Submittal: An action submittal requesting consideration of a comparable product, including the following information:

1. Identification of basis-of-design product or fabrication or installation method to be replaced,

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including Specification Section number and title and Drawing numbers and titles.
2. Data indicating compliance with the requirements specified in "Comparable Products" Article.

E. Basis-of-Design Product Specification Submittal: An action submittal complying with requirements in Section 013300 "Submittal Procedures."

F. Substitution: Refer to Section 012500 "Substitution Procedures" for definition and limitations on substitutions.

1.3 QUALITY ASSURANCE

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

1. Resolution of Compatibility Disputes between Multiple Contractors:

a. Contractors are responsible for providing products and construction methods compatible with products and construction methods of other contractors.
b. If a dispute arises between the multiple contractors over concurrently selectable but incompatible products, Architect will determine which products will be used.

B. Identification of Products: Except for required labels and operating data, do not attach or imprint manufacturer or product names or trademarks on exposed surfaces of products or equipment that will be exposed to view in occupied spaces or on the exterior.

1. Labels: Locate required product labels and stamps on a concealed surface, or, where required for observation following installation, on a visually accessible surface that is inconspicuous.
2. Equipment Nameplates: Provide a permanent nameplate on each item of service- or power-operated equipment. Locate on a visually accessible but inconspicuous surface. Include information essential for operation, including the following:

a. Name of product and manufacturer.
b. Model and serial number.
c. Capacity.
d. Speed.
e. Ratings.

3. See individual identification Sections in Divisions 21, 22, 23, and 26 for additional equipment identification requirements.

1.4 COORDINATION

A. Modify or adjust affected work as necessary to integrate work of approved comparable products and approved substitutions.

1.5 PRODUCT DELIVERY, STORAGE, AND HANDLING

A. Deliver, store, and handle products, using means and methods that will prevent damage, deterioration, and loss, including theft and vandalism. Comply with manufacturer's written instructions.

B. Delivery and Handling:

1. Schedule delivery to minimize long-term storage at Project site and to prevent overcrowding of construction spaces.
2. Coordinate delivery with installation time to ensure minimum holding time for items that are flammable, hazardous, easily damaged, or sensitive to deterioration, theft, and other losses.
3. Deliver products to Project site in an undamaged condition in manufacturer's original sealed container or other packaging system, complete with labels and instructions for handling, storing, unpacking, protecting, and installing.
4. Inspect products on delivery to determine compliance with the Contract Documents and that products are undamaged and properly protected.

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C. Storage:

1. Provide a secure location and enclosure at Project site for storage of materials and equipment.
2. Store products to allow for inspection and measurement of quantity or counting of units.
3. Store materials in a manner that will not endanger Project structure.
4. Store products that are subject to damage by the elements under cover in a weathertight enclosure above ground, with ventilation adequate to prevent condensation and with adequate protection from wind.
5. Protect foam plastic from exposure to sunlight, except to extent necessary for period of installation and concealment.
6. Comply with product manufacturer's written instructions for temperature, humidity, ventilation, and weather-protection requirements for storage.
7. Protect stored products from damage and liquids from freezing.
8. Provide a secure location and enclosure at Project site for storage of materials and equipment by Owner's construction forces. Coordinate location with Owner.

1.6 PRODUCT WARRANTIES

A. Warranties specified in other Sections are to be in addition to, and run concurrent with, other warranties required by the Contract Documents. Manufacturer's disclaimers and limitations on product warranties do not relieve Contractor of obligations under requirements of the Contract Documents.

1. Manufacturer's Warranty: Written standard warranty form furnished by individual manufacturer for a particular product and issued in the name of Owner or endorsed by manufacturer to Owner.
2. Special Warranty: Written warranty required by the Contract Documents to provide specific rights for Owner and issued in the name of Owner or endorsed by manufacturer to Owner.

B. Special Warranties: Prepare a written document that contains appropriate terms and identification, ready for execution.

1. Manufacturer's Standard Form: Modified to include Project-specific information and properly executed.
2. Specified Form: When specified forms are included in the Project Manual, prepare a written document, using indicated form properly executed.
3. See other Sections for specific content requirements and particular requirements for submitting special warranties.

C. Submittal Time: Comply with requirements in Section 017700 "Closeout Procedures."

PART 2 - PRODUCTS

2.1 PRODUCT SELECTION PROCEDURES

A. General Product Requirements: Provide products that comply with the Contract Documents, are undamaged and, unless otherwise indicated, are new at time of installation.

1. Provide products complete with accessories, trim, finish, fasteners, and other items needed for a complete installation and indicated use and effect.
2. Standard Products: If available, and unless custom products or nonstandard options are specified, provide standard products of types that have been produced and used successfully in similar situations on other projects.
3. Owner reserves the right to limit selection to products with warranties meeting requirements of the Contract Documents.
4. Where products are accompanied by the term "as selected," Architect will make selection.
5. Descriptive, performance, and reference standard requirements in Specifications establish salient characteristics of products.
6. Or Equal: For products specified by name and accompanied by the term "or equal," "or approved equal," or "or approved," comply with requirements in "Comparable Products" Article to obtain approval for use of an unnamed product.

    a. Submit additional documentation required by Architect in order to establish equivalency

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of proposed products. Unless otherwise indicated, evaluation of "or equal" product status is by Architect, whose determination is final.

B. Product Selection Procedures:

1. Sole Product: Where Specifications name a single manufacturer and product, provide the named product that complies with requirements. Comparable products or substitutions for Contractor's convenience will not be considered.

   a. Sole product may be indicated by the phrase "Subject to compliance with requirements, provide the following."

2. Sole Manufacturer/Source: Where Specifications name a single manufacturer or source, provide a product by the named manufacturer or source that complies with requirements. Comparable products or substitutions for Contractor's convenience will not be considered.

   a. Sole manufacturer/source may be indicated by the phrase "Subject to compliance with requirements, provide products by the following."

3. Limited List of Products: Where Specifications include a list of names of both manufacturers and products, provide one of the products listed that complies with requirements. Comparable products or substitutions for Contractor's convenience will be considered unless otherwise indicated .

   a. Limited list of products may be indicated by the phrase "Subject to compliance with requirements, provide one of the following."

4. Non-Limited List of Products: Where Specifications include a list of names of both available manufacturers and products, provide one of the products listed or an unnamed product that complies with requirements.

   a. Non-limited list of products is indicated by the phrase "Subject to compliance with requirements, available products that may be incorporated in the Work include, but are not limited to, the following."
   b. Provision of an unnamed product is not considered a substitution, if the product complies with requirements.

5. Limited List of Manufacturers: Where Specifications include a list of manufacturers' names, provide a product by one of the manufacturers listed that complies with requirements. Comparable products or substitutions for Contractor's convenience will be considered unless otherwise indicated .

   a. Limited list of manufacturers is indicated by the phrase "Subject to compliance with requirements, provide products by one of the following."

6. Non-Limited List of Manufacturers: Where Specifications include a list of available manufacturers, provide a product by one of the manufacturers listed or a product by an unnamed manufacturer that complies with requirements.

   a. Non-limited list of manufacturers is indicated by the phrase "Subject to compliance with requirements, available manufacturers whose products may be incorporated in the Work include, but are not limited to, the following."
   b. Provision of products of an unnamed manufacturer is not considered a substitution, if the product complies with requirements.

7. Basis-of-Design Product: Where Specifications name a product, or refer to a product indicated on Drawings, and include a list of manufacturers, provide the specified or indicated product or a comparable product by one of the other named manufacturers. Drawings and Specifications may additionally indicate sizes, profiles, dimensions, and other characteristics that are based on the product named. Comply with requirements in "Comparable Products" Article for consideration of an unnamed product by one of the other named manufacturers.

   a. For approval of products by unnamed manufacturers, comply with requirements in Section 012500 "Substitution Procedures" for substitutions for convenience.

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C. Visual Matching Specification: Where Specifications require the phrase "match Architect's sample," provide a product that complies with requirements and matches Architect's sample. Architect's decision will be final on whether a proposed product matches.

1. If no product available within specified category matches and complies with other specified requirements, comply with requirements in Section 012500 "Substitution Procedures" for proposal of product.

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

E. Sustainable Product Selection: Where Specifications require product to meet sustainable product characteristics, select products complying with indicated requirements. Comply with requirements in Division 01 sustainability requirements Section and individual Specification Sections.

2.2 COMPARABLE PRODUCTS

A. Conditions for Consideration of Comparable Products: Architect will consider Contractor's request for comparable product when the following conditions are satisfied. If the following conditions are not satisfied, Architect may return requests without action, except to record noncompliance with the following requirements:

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

B. Architect's Action on Comparable Products Submittal: If necessary, Architect will request additional information or documentation for evaluation within seven days of receipt of a request for a comparable product. Architect will notify Contractor of approval or rejection of proposed comparable product within 15 days of receipt of request, or seven days of receipt of additional information or documentation, whichever is later.

1. Architect's Approval of Submittal: Marked with approval notation from Architect's action stamp . See Section 013300 "Submittal Procedures."
2. Use product specified if Architect does not issue a decision on use of a comparable product request within time allocated.

C. Submittal Requirements, Two-Step Process: Approval by Architect of Contractor's request for use of comparable product is not intended to satisfy other submittal requirements. Comply with specified submittal requirements.

D. Submittal Requirements, Single-Step Process: When acceptable to Architect, incorporate specified submittal requirements of individual Specification Section in combined submittal for comparable products. Approval by Architect of Contractor's request for use of comparable product and of individual submittal requirements will also satisfy other submittal requirements.

PART 3 - EXECUTION (Not Used)

END OF SECTION 01 60 00

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SECTION 01 73 00 - EXECUTION

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes general administrative and procedural requirements governing execution of the Work, including, but not limited to, the following:

1. Construction layout.
2. Field engineering.
3. Installation.
4. Cutting and patching.
5. Coordination of Owner's portion of the Work.
6. Progress cleaning.
7. Starting and adjusting.
8. Protection of installed construction.
9. Correction of the Work.

B. Related Requirements:

1. Section 011000 "Summary" for coordination of Owner-furnished products , Owner-performed work , and limits on use of Project site.
2. Section 013300 "Submittal Procedures" for submitting surveys.
3. Section 017700 "Closeout Procedures" for submitting final property survey with Project Record Documents, recording of Owner-accepted deviations from indicated lines and levels, replacing defective work, and final cleaning.
4. Section 024119 "Selective Demolition" for demolition and removal of selected portions of the building.
5. Section 078413 "Penetration Firestopping" for patching penetrations in fire-rated construction.

1.2 DEFINITIONS

A. Cutting: Removal of in-place construction necessary to permit installation or performance of subsequent work.

B. Patching: Fitting and repair work required to restore construction to original conditions after installation of subsequent work.

1.3 PREINSTALLATION MEETINGS

A. Cutting and Patching Conference: Conduct conference at Project site .

1. Prior to commencing work requiring cutting and patching , review extent of cutting and patching anticipated and examine procedures for ensuring satisfactory result from cutting and patching work. Inform Architect of scheduled meeting. Require representatives of each entity directly concerned with cutting and patching to attend, including the following:

   a. Contractor's superintendent.
   b. Trade supervisor responsible for cutting operations.
   c. Trade supervisor(s) responsible for patching of each type of substrate.
   d. Mechanical, electrical, and utilities subcontractors' supervisors, to the extent each trade is affected by cutting and patching operations.

2. Review areas of potential interference and conflict. Coordinate procedures and resolve potential conflicts before proceeding.

B. Layout Conference: Conduct conference at Project site .

1. Prior to establishing layout of new and existing perimeter and structural column grid(s), review building location requirements. Review benchmark, control point, and layout and dimension

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requirements. Inform Architect of scheduled meeting. Require representatives of each entity directly concerned with Project layout to attend, including the following:

a. Contractor's superintendent.
b. Professional surveyor responsible for performing Project surveying and layout.
c. Professional surveyor responsible for performing site survey serving as basis for Project design.

2. Review meanings and intent of dimensions, notes, terms, graphic symbols, and other layout information indicated on the Drawings.
3. Review requirements for including layouts on Shop Drawings and other submittals.
4. Review areas of potential interference and conflict. Coordinate procedures and resolve potential conflicts before proceeding.

1.4 INFORMATIONAL SUBMITTALS

A. Qualification Data: For professional engineer .

B. Certificates: Submit certificate signed by professional engineer , certifying that location and elevation of improvements comply with requirements.

C. Cutting and Patching Plan: Submit plan describing procedures at least 10 days prior to the time cutting and patching will be performed. Include the following information:

1. Extent: Describe reason for and extent of each occurrence of cutting and patching.
2. Changes to In-Place Construction: Describe anticipated results. Include changes to structural elements and operating components as well as changes in building appearance and other significant visual elements.
3. Products: List products to be used for patching and firms or entities that will perform patching work.
4. Dates: Indicate when cutting and patching will be performed.
5. Utilities and Mechanical and Electrical Systems: List services and systems that cutting and patching procedures will disturb or affect. List services and systems that will be relocated and those that will be temporarily out of service. Indicate length of time permanent services and systems will be disrupted.

a. Include description of provisions for temporary services and systems during interruption of permanent services and systems.

D. Landfill Receipts: Submit copy of receipts issued by a landfill facility, licensed to accept hazardous materials, for hazardous waste disposal.

1.5 CLOSEOUT SUBMITTALS

A. Final Property Survey: Submit 10 copies showing the Work performed and record survey data.

1.6 QUALITY ASSURANCE

A. Land Surveyor Qualifications: A professional land surveyor who is legally qualified to practice in jurisdiction where Project is located and who is experienced in providing land-surveying services of the kind indicated.

B. Professional Engineer Qualifications: Refer to Section 014000 "Quality Requirements."

C. Cutting and Patching: Comply with requirements for and limitations on cutting and patching of construction elements.

1. Structural Elements: When cutting and patching structural elements, or when encountering the need for cutting and patching of elements whose structural function is not known, notify Architect of locations and details of cutting and await directions from Architect before proceeding. Shore, brace, and support structural elements during cutting and patching. Do not cut and patch structural elements in a manner that could change their load-carrying capacity or increase deflection.

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2. Operational Elements: Do not cut and patch operating elements and related components in a manner that results in reducing their capacity to perform as intended or that results in increased maintenance or decreased operational life or safety. Operational elements include the following:

    a. Primary operational systems and equipment.
    b. Fire separation assemblies.
    c. Air or smoke barriers.
    d. Fire-suppression systems.
    e. Plumbing piping systems.
    f. Mechanical systems piping and ducts.
    g. Control systems.
    h. Communication systems.
    i. Fire-detection and -alarm systems.
    j. Conveying systems.
    k. Electrical wiring systems.
    l. Operating systems of special construction.

3. Other Construction Elements: Do not cut and patch other construction elements or components in a manner that could change their load-carrying capacity, that results in reducing their capacity to perform as intended, or that results in increased maintenance or decreased operational life or safety. Other construction elements include but are not limited to the following:

    a. Water, moisture, or vapor barriers.
    b. Membranes and flashings.
    c. Exterior curtain-wall construction.
    d. Sprayed fire-resistive material.
    e. Equipment supports.
    f. Piping, ductwork, vessels, and equipment.
    g. Noise- and vibration-control elements and systems.

4. Visual Elements: Do not cut and patch construction in a manner that results in visual evidence of cutting and patching. Do not cut and patch exposed construction in a manner that would, in Architect's opinion, reduce the building's aesthetic qualities. Remove and replace construction that has been cut and patched in a visually unsatisfactory manner.

D. Manufacturer's Installation Instructions: Obtain and maintain on-site manufacturer's written recommendations and instructions for installation of specified products and equipment.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Comply with requirements specified in other Sections.

1. For projects requiring compliance with sustainable design and construction practices and procedures, use products for patching that comply with sustainable design requirements.

B. In-Place Materials: Use materials for patching identical to in-place materials. For exposed surfaces, use materials that visually match in-place adjacent surfaces to the fullest extent possible.

1. If identical materials are unavailable or cannot be used, use materials that, when installed, will provide a match acceptable to Architect for the visual and functional performance of in-place materials. Use materials that are not considered hazardous.

C. Cleaning Agents: Use cleaning materials and agents recommended by manufacturer or fabricator of the surface to be cleaned. Do not use cleaning agents that are potentially hazardous to health or property or that might damage finished surfaces.

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PART 3 - EXECUTION

3.1 EXAMINATION

A. Existing Conditions: The existence and location of underground and other utilities and construction indicated as existing are not guaranteed. Before beginning sitework, investigate and verify the existence and location of underground utilities, mechanical and electrical systems, and other construction affecting the Work.

1. Before construction, verify the location and invert elevation at points of connection of sanitary sewer, storm sewer, gas service piping, and water-service piping; underground electrical services; and other utilities.
2. Furnish location data for work related to Project that must be performed by public utilities serving Project site.

B. Examination and Acceptance of Conditions: Before proceeding with each component of the Work, examine substrates, areas, and conditions, with Installer or Applicator present where indicated, for compliance with requirements for installation tolerances and other conditions affecting performance. Record observations.

1. Examine roughing-in for mechanical and electrical systems to verify actual locations of connections before equipment and fixture installation.
2. Examine walls, floors, and roofs for suitable conditions where products and systems are to be installed.
3. Verify compatibility with and suitability of substrates, including compatibility with existing finishes or primers.

C. Written Report: Where a written report listing conditions detrimental to performance of the Work is required by other Sections, include the following:

1. Description of the Work, including Specification Section number and paragraph, and Drawing sheet number and detail, where applicable.
2. List of detrimental conditions, including substrates.
3. List of unacceptable installation tolerances.
4. Recommended corrections.

D. Proceed with installation only after unsatisfactory conditions have been corrected. Proceeding with the Work indicates acceptance of surfaces and conditions.

3.2 PREPARATION

A. Existing Utility Information: Furnish information to Owner that is necessary to adjust, move, or relocate existing utility structures, utility poles, lines, services, or other utility appurtenances located in or affected by construction. Coordinate with authorities having jurisdiction.

B. Field Measurements: Take field measurements as required to fit the Work properly. Recheck measurements before installing each product. Where portions of the Work are indicated to fit to other construction, verify dimensions of other construction by field measurements before fabrication. Coordinate fabrication schedule with construction progress to avoid delaying the Work.

C. Space Requirements: Verify space requirements and dimensions of items shown diagrammatically on Drawings.

D. Review of Contract Documents and Field Conditions: Immediately on discovery of the need for clarification of the Contract Documents, submit a request for information to Architect in accordance with requirements in Section 013100 "Project Management and Coordination."

3.3 CONSTRUCTION LAYOUT

A. Verification: Before proceeding to lay out the Work, verify layout information shown on Drawings, in relation to the property survey and existing benchmarks and existing conditions. If discrepancies are discovered, notify Architect promptly.

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B. Engage a professional engineer experienced in laying out the Work, using the following accepted surveying practices:

1. Establish benchmarks and control points to set lines and levels at each story of construction and elsewhere as needed to locate each element of Project.
2. Establish limits on use of Project site.
3. Establish dimensions within tolerances indicated. Do not scale Drawings to obtain required dimensions.
4. Inform installers of lines and levels to which they must comply.
5. Check the location, level and plumb, of every major element as the Work progresses.
6. Notify Architect when deviations from required lines and levels exceed allowable tolerances.
7. Close site surveys with an error of closure equal to or less than the standard established by authorities having jurisdiction.

C. Site Improvements: Locate and lay out site improvements, including pavements, grading, fill and topsoil placement, utility slopes, and rim and invert elevations.

D. Building Lines and Levels: Locate and lay out control lines and levels for structures, building foundations, column grids, and floor levels, including those required for mechanical and electrical work. Transfer survey markings and elevations for use with control lines and levels. Level foundations and piers from two or more locations.

E. Record Log: Maintain a log of layout control work. Record deviations from required lines and levels. Include beginning and ending dates and times of surveys, weather conditions, name and duty of each survey party member, and types of instruments and tapes used. Make the log available for reference by Architect .

3.4 FIELD ENGINEERING

A. Identification: Owner will identify existing benchmarks, control points, and property corners.

B. Reference Points: Locate existing permanent benchmarks, control points, and similar reference points before beginning the Work. Preserve and protect permanent benchmarks and control points during construction operations.

1. Do not change or relocate existing benchmarks or control points without prior written approval of Architect . Report lost or destroyed permanent benchmarks or control points promptly. Report the need to relocate permanent benchmarks or control points to Architect before proceeding.
2. Replace lost or destroyed permanent benchmarks and control points promptly. Base replacements on the original survey control points.

C. Benchmarks: Establish and maintain a minimum of two permanent benchmarks on Project site, referenced to data established by survey control points. Comply with authorities having jurisdiction for type and size of benchmark.

1. Record benchmark locations, with horizontal and vertical data, on Project Record Documents.
2. Where the actual location or elevation of layout points cannot be marked, provide temporary reference points sufficient to locate the Work.
3. Remove temporary reference points when no longer needed. Restore marked construction to its original condition.

D. Certified Survey: On completion of foundation walls, major site improvements, and other work requiring field-engineering services, prepare a certified survey showing dimensions, locations, angles, and elevations of construction and sitework.

E. Final Property Survey: Engage a professional engineer to prepare a final property survey showing significant features (real property) for Project. Include on the survey a certification, signed by professional engineer , that principal metes, bounds, lines, and levels of Project are accurately positioned as shown on the survey.

1. Show boundary lines, monuments, streets, site improvements and utilities, existing improvements and significant vegetation, adjoining properties, acreage, grade contours, and the distance and bearing from a site corner to a legal point.

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3.5 INSTALLATION

A. Locate the Work and components of the Work accurately, in correct alignment and elevation, as indicated.

1. Make vertical work plumb, and make horizontal work level.
2. Where space is limited, install components to maximize space available for maintenance and ease of removal for replacement.
3. Conceal pipes, ducts, and wiring in finished areas unless otherwise indicated.
4. Maintain minimum headroom clearance of 96 inches in occupied spaces and 90 inches in unoccupied spaces, unless otherwise indicated on Drawings.

B. Comply with manufacturer's written instructions and recommendations for installing products in applications indicated.

C. Install products at the time and under conditions that will ensure satisfactory results as judged by Architect. Maintain conditions required for product performance until Substantial Completion.

D. Conduct construction operations, so no part of the Work is subjected to damaging operations or loading in excess of that expected during normal conditions of occupancy of type expected for Project.

E. Sequence the Work and allow adequate clearances to accommodate movement of construction items on-site and placement in permanent locations.

F. Tools and Equipment: Select tools or equipment that minimize production of excessive noise levels.

G. Templates: Obtain and distribute to the parties involved templates for Work specified to be factory prepared and field installed. Check Shop Drawings of other portions of the Work to confirm that adequate provisions are made for locating and installing products to comply with indicated requirements.

H. Attachment: Provide blocking and attachment plates and anchors and fasteners of adequate size and number to securely anchor each component in place, accurately located and aligned with other portions of the Work. Where size and type of attachments are not indicated, verify size and type required for load conditions with manufacturer.

1. Mounting Heights: Where mounting heights are not indicated, mount components at heights directed by Architect.
2. Allow for building movement, including thermal expansion and contraction.
3. Coordinate installation of anchorages. 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.

I. Joints: Make joints of uniform width. Where joint locations in exposed Work are not indicated, arrange joints for the best visual effect, as judged by Architect. Fit exposed connections together to form hairline joints.

3.6 CUTTING AND PATCHING

A. General: Employ skilled workers to perform cutting and patching. Proceed with cutting and patching at the earliest feasible time, and complete without delay.

1. Cut in-place construction to provide for installation of other components or performance of other construction, and subsequently patch as required to restore surfaces to their original condition.

B. Existing Warranties: Remove, replace, patch, and repair materials and surfaces cut or damaged during installation or cutting and patching operations, by methods and with materials so as not to void existing warranties.

C. Temporary Support: Provide temporary support of Work to be cut.

D. Protection: Protect in-place construction during cutting and patching to prevent damage. Provide protection from adverse weather conditions for portions of Project that might be exposed during cutting and patching operations.

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E. Adjacent Occupied Areas: Where interference with use of adjoining areas or interruption of free passage to adjoining areas is unavoidable, coordinate cutting and patching in accordance with requirements in Section 011000 "Summary."

F. Existing Utility Services and Mechanical/Electrical Systems: Where existing services/systems are required to be removed, relocated, or abandoned, bypass such services/systems before cutting to minimize interruption to occupied areas.

G. 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 neatly to minimum 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 a cutting machine, such as an abrasive saw or a diamond-core drill.
4. Excavating and Backfilling: Comply with requirements in applicable Sections where required by cutting and patching operations.
5. 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.
6. Proceed with patching after construction operations requiring cutting are complete.

H. 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 practicable, as judged by Architect. Provide materials and comply with installation requirements specified in other Sections, where applicable.

1. Inspection: Where feasible, test and inspect patched areas after completion to demonstrate physical integrity of installation.
2. 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.

3. Floors and Walls: Where walls or partitions that are removed extend one finished area into another, patch and repair floor and wall surfaces in the new space. Provide an even surface of uniform finish, color, texture, and appearance. Remove in-place floor and wall coverings and replace with new materials, if necessary, to achieve uniform color and appearance.

   a. Where patching occurs in a painted surface, prepare substrate and apply primer and intermediate paint coats appropriate for substrate over the patch, and apply final paint coat over entire unbroken surface containing the patch, corner to corner of wall and edge to edge of ceiling. Provide additional coats until patch blends with adjacent surfaces.

4. Ceilings: Patch, repair, or rehang in-place ceilings as necessary to provide an even-plane surface of uniform appearance.
5. Exterior Building Enclosure: Patch components in a manner that restores enclosure to a weathertight condition and ensures thermal and moisture integrity of building enclosure.

I. Cleaning: Clean areas and spaces where cutting and patching are performed. Remove paint, mortar, oils, putty, and similar materials from adjacent finished surfaces.

3.7 COORDINATION OF OWNER'S PORTION OF THE WORK

A. Site Access: Provide access to Project site for Owner's construction personnel .

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1. Provide temporary facilities required for Owner-furnished, Contractor-installed and Owner-furnished, Owner-installed products.
2. Refer to Section 011000 "Summary" for other requirements for Owner-furnished, Contractor-installed and Owner-furnished, Owner-installed products.

B. Coordination: Coordinate construction and operations of the Work with work performed by Owner's construction personnel .

1. Construction Schedule: Inform Owner of Contractor's preferred construction schedule for Owner's portion of the Work. Adjust construction schedule based on a mutually agreeable timetable. Notify Owner if changes to schedule are required due to differences in actual construction progress.
2. Preinstallation Conferences: Include Owner's construction personnel at preinstallation conferences covering portions of the Work that are to receive Owner's work. Attend preinstallation conferences conducted by Owner's construction personnel if portions of the Work depend on Owner's construction.

3.8 PROGRESS CLEANING

A. Clean Project site and work areas daily, including common areas. Enforce requirements strictly. Dispose of materials lawfully.

1. Comply with requirements in NFPA 241 for removal of combustible waste materials and debris.
2. Do not hold waste materials more than seven days during normal weather or three days if the temperature is expected to rise above **80 deg F**.
3. Containerize hazardous and unsanitary waste materials separately from other waste. Mark containers appropriately and dispose of legally, in accordance with regulations.

   a. Use containers intended for holding waste materials of type to be stored.

4. Coordinate progress cleaning for joint-use areas where Contractor and other contractors are working concurrently.

B. Site: Maintain Project site free of waste materials and debris.

C. Work Areas: Clean areas where Work is in progress to the level of cleanliness necessary for proper execution of the Work.

1. Remove liquid spills promptly.
2. Where dust would impair proper execution of the Work, broom-clean or vacuum the entire work area, as appropriate.

D. Installed Work: Keep installed work clean. Clean installed surfaces in accordance with 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.

E. Concealed Spaces: Remove debris from concealed spaces before enclosing the space.

F. Exposed Surfaces: Clean exposed surfaces and protect as necessary to ensure freedom from damage and deterioration at time of Substantial Completion.

G. Waste Disposal: Do not bury or burn waste materials on-site. Do not wash waste materials down sewers or into waterways. Comply with waste disposal requirements in Section 017419 "Construction Waste Management and Disposal."

H. During handling and installation, clean and protect construction in progress and adjoining materials already in place. Apply protective covering where required to ensure protection from damage or deterioration at Substantial Completion.

I. Clean and provide maintenance on completed construction as frequently as necessary through the remainder of the construction period. Adjust and lubricate operable components to ensure operability without damaging effects.

J. Limiting Exposures: Supervise construction operations to ensure that no part of the construction,

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completed or in progress, is subject to harmful, dangerous, damaging, or otherwise deleterious exposure during the construction period.

3.9 STARTING AND ADJUSTING

A. Coordinate startup and adjusting of equipment and operating components with requirements in Section 019113 "General Commissioning Requirements."

B. Start equipment and operating components to confirm proper operation. Remove malfunctioning units, replace with new units, and retest.

C. Adjust equipment for proper operation. Adjust operating components for proper operation without binding.

D. Test each piece of equipment to verify proper operation. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

E. Manufacturer's Field Service: Comply with qualification requirements in Section 014000 "Quality Requirements."

3.10 PROTECTION OF INSTALLED CONSTRUCTION

A. Provide final protection and maintain conditions that ensure installed Work is without damage or deterioration at time of Substantial Completion.

B. Protection of Existing Items: Provide protection and ensure that existing items to remain undisturbed by construction are maintained in condition that existed at commencement of the Work.

C. Comply with manufacturer's written instructions for temperature and relative humidity.

3.11 CORRECTION OF THE WORK

A. Repair or remove and replace damaged, defective, or nonconforming Work. Restore damaged substrates and finishes.

1. Repairing includes replacing defective parts, refinishing damaged surfaces, touching up with matching materials, and properly adjusting operating equipment.

B. Repair Work previously completed and subsequently damaged during construction period. Repair to like-new condition.

C. Restore permanent facilities used during construction to their specified condition.

D. Remove and replace damaged surfaces that are exposed to view if surfaces cannot be repaired without visible evidence of repair.

E. Repair components that do not operate properly. Remove and replace operating components that cannot be repaired.

F. Remove and replace chipped, scratched, and broken glass or reflective surfaces.

END OF SECTION 01 73 00

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SECTION 01 74 19 - CONSTRUCTION WASTE MANAGEMENT AND DISPOSAL

PART 1 - GENERAL

1.1 SUMMARY

A. The Work of this Section includes administrative and procedural requirements for the following:

1. Salvaging nonhazardous demolition and construction waste.
2. Recycling nonhazardous demolition and construction waste.
3. Disposing of nonhazardous demolition and construction waste.

1.2 DEFINITIONS

A. CMU: Concrete masonry units.

B. Construction Waste: Building, structure, and site improvement materials and other solid waste resulting from construction, remodeling, renovation, or repair operations. Construction waste includes packaging.

C. Demolition Waste: Building, structure, and site improvement materials resulting from demolition operations.

D. Disposal: Removal of demolition or construction waste and subsequent salvage, sale, recycling, or deposit in landfill, incinerator acceptable to authorities having jurisdiction, or designated spoil areas on Owner's property.

E. Recycle: Recovery of demolition or construction waste for subsequent processing in preparation for reuse.

F. Salvage: Recovery of demolition or construction waste and subsequent sale or reuse in another facility.

G. Salvage and Reuse: Recovery of demolition or construction waste and subsequent incorporation into the Work.

1.3 MATERIALS OWNERSHIP

A. Unless otherwise indicated, demolition and construction waste becomes property of Contractor.

B. Historic items, relics, antiques, and similar objects including, but not limited to, cornerstones and their contents, commemorative plaques and tablets, and other items of interest or value to Owner that may be uncovered during demolition remain the property of Owner.

1. Carefully salvage in a manner to prevent damage and promptly return to Owner.

1.4 ACTION SUBMITTALS

A. Waste Management Plan: Submit plan within 7 days of date established for commencement of the Work . Plan must include the following:

1. Strategies to reduce the generation of waste during Project design and construction.
2. Waste diversion goals for Project, identifying the materials (both structural and nonstructural) targeted for recycling, reuse, or salvage and identifying the target diversion percentage (at least 50 percent).
3. Where materials will be taken, including expected diversion rates for each material.

1.5 QUALITY ASSURANCE

A. Waste Management Coordinator Qualifications: Experienced firm, or individual employed and

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assigned by General Contractor, with a record of successful waste management coordination of projects with similar requirements. Superintendent may serve as Waste Management Coordinator.

B. Refrigerant Recovery Technician Qualifications:

1. Universal , certified by EPA-approved certification program.
2. Comply with requirements in Section 024119 "Selective Demolition."

C. Regulatory Requirements: Comply with transportation and disposal regulations of authorities having jurisdiction.

D. Waste Management Conference(s): Conduct conference(s) at Project site to comply with requirements in Section 013100 "Project Management and Coordination." Review methods and procedures related to waste management including, but not limited to, the following:

1. Review and discuss waste management plan including responsibilities of each contractor and waste management coordinator.
2. Review requirements for documenting quantities of each type of waste and its disposition.
3. Review and finalize procedures for materials separation, and verify availability of containers and bins needed to avoid delays.
4. Review procedures for periodic waste collection and transportation to recycling and disposal facilities.
5. Review waste management requirements for each trade.

1.6 WASTE MANAGEMENT PLAN

A. General: Develop a waste management plan in accordance with requirements in this Section. Plan must include provisions for waste identification, waste reduction work plan, and cost/revenue analysis. Indicate quantities by weight or volume, but use same units of measure throughout waste management plan.

PART 2 - PRODUCTS (Not Used)
PART 3 - EXECUTION

3.1 PLAN IMPLEMENTATION

A. General: Implement approved waste management plan. Provide handling, containers, storage, signage, transportation, and other items as required to implement waste management plan during entire duration of the Contract.

1. Comply with operation, termination, and removal requirements in Section 015000 "Temporary Facilities and Controls."

B. Waste Management Coordinator: Engage a waste management coordinator to be responsible for implementing, monitoring, and reporting status of waste management work plan.

C. Training: Train workers, subcontractors, and suppliers on proper waste management procedures, as appropriate for the Work.

1. Distribute waste management plan to everyone concerned within three days of submittal return.
2. Distribute waste management plan to entities when they first begin work on-site. Review plan procedures and locations established for salvage, recycling, and disposal.

D. Site Access and Temporary Controls: Conduct waste management operations to ensure minimum interference with roads, streets, walks, walkways, and other adjacent occupied and used facilities.

1. Designate and label specific areas on Project site necessary for separating materials that are to be salvaged and recycled.
2. Comply with Section 015000 "Temporary Facilities and Controls" for controlling dust and dirt, environmental protection, and noise control.

E. Waste Management in Historic Zones or Areas: Transportation equipment and other materials are to be of sizes that clear surfaces within historic spaces, areas, rooms, and openings, by 12 inches or more.

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3.2 SALVAGING DEMOLITION WASTE

A. Comply with requirements in Section 024119 "Selective Demolition" for salvaging demolition waste.

B. Salvaged Items for Reuse in the Work: Handle as follows:

1. Clean salvaged items.
2. Pack or crate items after cleaning. Identify contents of containers with label indicating elements, date of removal, quantity, and location where removed.
3. Store items in a secure area until installation.
4. Protect items from damage during transport and storage.
5. Install salvaged items to comply with installation requirements for new materials and equipment. Provide connections, supports, and miscellaneous materials necessary to make items functional for use indicated.

C. Salvaged Items for Sale or Donation: Not permitted on Project site.

D. Salvaged Items for Owner's Use: Handle as follows:

1. Clean salvaged items.
2. Pack or crate items after cleaning. Identify contents of containers with label indicating elements, date of removal, quantity, and location where removed.
3. Store items in a secure area until delivery to Owner.
4. Transport items to Owner's storage area designated by Owner .
5. Protect items from damage during transport and storage.

E. Doors and Hardware: Brace open end of door frames. Except for removing door closers, leave door hardware attached to doors.

F. Equipment: Drain tanks, piping, and fixtures. Seal openings with caps or plugs. Protect equipment from exposure to weather.

G. Plumbing Fixtures: Separate by type and size.

H. Lighting Fixtures: Separate lamps by type and protect from breakage.

I. Electrical Devices: Separate switches, receptacles, switchgear, transformers, meters, panelboards, circuit breakers, and other devices by type.

3.3 RECYCLING DEMOLITION AND CONSTRUCTION WASTE, GENERAL

A. General: Recycle paper and beverage containers used by on-site workers.

B. Recycling Incentives: Revenues, savings, rebates, tax credits, and other incentives received for recycling waste materials to be shared equally by Owner and Contractor .

C. Preparation of Waste: Prepare and maintain recyclable waste materials in accordance with recycling or reuse facility requirements. Maintain materials free of dirt, adhesives, solvents, petroleum contamination, and other substances deleterious to the recycling process.

D. Procedures: Separate recyclable waste from other waste materials, trash, and debris. Separate recyclable waste by type at Project site to maximum extent practical in accordance with approved construction waste management plan.

1. Provide appropriately marked containers or bins for controlling recyclable waste until removed from Project site. Include list of acceptable and unacceptable materials at each container and bin.

    a. Inspect containers and bins for contamination, and remove contaminated materials if found.

2. Stockpile processed materials on-site without intermixing with other materials. Place, grade, and shape stockpiles to drain surface water. Cover to prevent windblown dust.
3. Stockpile materials away from construction area. Do not store within drip line of remaining trees.

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4. Store components off the ground and protect from the weather.
5. Remove recyclable waste from Owner's property and transport to recycling receiver or processor as often as required to prevent overfilling bins.

3.4 RECYCLING DEMOLITION WASTE

A. Asphalt Paving for Fill: Grind asphalt to maximum 4-inch size.

1. Crush asphaltic concrete paving and screen to comply with requirements in Section 312000 "Earth Moving" for use as general fill.

B. Asphalt Paving Recycling: Break up and transport paving to asphalt-recycling facility.

C. Concrete: Remove reinforcement and other metals from concrete and sort with other metals.

1. Pulverize concrete to maximum 4-inch size.
2. Crush concrete and screen to comply with requirements in Section 312000 "Earth Moving" for use as satisfactory soil for fill or subbase.

D. Masonry: Remove metal reinforcement, anchors, and ties from masonry and sort with other metals.

1. Pulverize masonry to maximum 4-inch size.
2. Clean and stack undamaged, whole masonry units on wood pallets.

E. Wood Materials: Sort and stack members per size, type, and length. Separate lumber, engineered wood products, panel products, and treated wood materials.

F. Metals: Separate metals by type.

1. Structural Steel: Stack members per size, type of member, and length.
2. Remove and dispose of bolts, nuts, washers, and other rough hardware.

G. Asphalt Shingle Roofing: Separate organic and glass-fiber asphalt shingles and felts. Remove and dispose of nails, staples, and accessories.

H. Gypsum Board: Stack large clean pieces on wood pallets or in containers and store in a dry location. Remove edge trim and sort with other metals. Remove and dispose of fasteners.

I. Acoustical Ceiling Panels and Tile: Stack large clean pieces on wood pallets and store in a dry location.

J. Metal Suspension System: Separate metal members, including trim and other metals from acoustical panels and tile, and sort with other metals.

K. Carpet and Pad: Roll large pieces tightly after removing debris, trash, adhesive, and tack strips.

1. Store clean, dry carpet and pad in a closed container or trailer provided by carpet reclamation agency or carpet recycler.

L. Carpet Tile: Remove debris, trash, and adhesive.

1. Stack tile on pallet and store clean, dry carpet in a closed container or trailer provided by carpet reclamation agency or carpet recycler.

M. Piping: Reduce piping to straight lengths and store by material and size. Separate supports, hangers, valves, sprinklers, and other components by material and size.

N. Conduit: Reduce conduit to straight lengths and store by material and size.

O. Lamps: Separate lamps by type and store in accordance with requirements in 40 CFR 273.

3.5 RECYCLING CONSTRUCTION WASTE

A. Packaging:

1. Cardboard and Boxes: Break down packaging into flat sheets. Bundle and store in a dry

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location.
2. Polystyrene Packaging: Separate and bag materials.
3. Pallets: As much as possible, require deliveries using pallets to remove pallets from Project site. For pallets that remain on-site, break down pallets into component wood pieces and comply with requirements for recycling wood.
4. Crates: Break down crates into component wood pieces and comply with requirements for recycling wood.

B. Wood Materials:

1. Clean Cutoffs of Lumber: Grind or chip into small pieces.
2. Clean Sawdust: Bag sawdust that does not contain painted or treated wood.

C. Gypsum Board: Stack large clean pieces on wood pallets or in containers and store in a dry location.

D. Paint: Seal containers and store by type.

3.6 DISPOSAL OF WASTE

A. Except for items or materials to be salvaged or recycled, remove waste materials from Project site and legally dispose of them in a landfill or incinerator acceptable to authorities having jurisdiction.

1. Unless otherwise specified, do not allow waste materials that are to be disposed of accumulate on-site.
2. Remove and transport debris in a manner that will prevent spillage on adjacent surfaces and areas.

B. Except for items or materials to be salvaged or recycled, remove waste materials and legally dispose of at designated spoil areas on Owner's property.

C. Burning:

1. Do not burn waste materials.

END OF SECTION 01 74 19

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SECTION 01 77 00 - CLOSEOUT PROCEDURES

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes administrative and procedural requirements for Contract closeout, including, but not limited to, the following:

1. Substantial Completion procedures.
2. Final Completion procedures.
3. List of incomplete items.
4. Submittal of Project warranties.
5. Final cleaning.

B. Related Requirements:

1. Section 012900 "Payment Procedures" for requirements for Applications for Payment for Substantial Completion and Final Completion.
2. Section 013233 "Photographic Documentation" for submitting Final Completion construction photographic documentation.
3. Section 017823 "Operation and Maintenance Data" for additional operation and maintenance manual requirements.
4. Section 017839 "Project Record Documents" for submitting Record Drawings, Record Specifications, and Record Product Data.
5. Section 017900 "Demonstration and Training" for requirements to train Owner's maintenance personnel to adjust, operate, and maintain products, equipment, and systems.

1.2 DEFINITIONS

A. List of Incomplete Items: Contractor-prepared list of items to be completed or corrected, prepared for the Architect's use prior to Architect's inspection, to determine if the Work is substantially complete.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of cleaning agent.

B. Contractor's List of Incomplete Items: Initial submittal at Substantial Completion.

C. Certified List of Incomplete Items: Final submittal at Final Completion.

1.4 CLOSEOUT SUBMITTALS

A. Certificates of Release: From authorities having jurisdiction.

B. Certificate of Insurance: For continuing coverage.

C. Field Report: For pest-control inspection.

1.5 MAINTENANCE MATERIAL SUBMITTALS

A. Schedule of Maintenance Material Items: For maintenance material submittal items required by other Sections.

1.6 SUBSTANTIAL COMPLETION PROCEDURES

A. Contractor's List of Incomplete Items: Prepare and submit a list of items to be completed and corrected (Contractor's "punch list"), indicating the value of each item on the list and reasons why the Work is incomplete.

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B. Submittals Prior to Substantial Completion: Complete the following a minimum of 10 days prior to requesting inspection for determining date of Substantial Completion. List items below that are incomplete at time of request.

1. Certificates of Release: Obtain and submit releases from authorities having jurisdiction, permitting Owner unrestricted use of the Work and access to services and utilities. Include occupancy permits, operating certificates, and similar releases.
2. Submit closeout submittals specified in other Division 01 Sections, including Project Record Documents, operation and maintenance manuals, damage or settlement surveys, property surveys, and similar final record information.
3. Submit closeout submittals specified in individual Sections, including specific warranties, workmanship bonds, maintenance service agreements, final certifications, and similar documents.
4. Submit maintenance material submittals specified in individual Sections, including tools, spare parts, extra materials, and similar items, and deliver to location designated by Architect . Label with manufacturer's name and model number.
5. Submit testing, adjusting, and balancing records.
6. Submit changeover information related to Owner's occupancy, use, operation, and maintenance.

C. Procedures Prior to Substantial Completion: Complete the following a minimum of 10 days prior to requesting inspection for determining date of Substantial Completion. List items below that are incomplete at time of request.

1. Advise Owner of pending insurance changeover requirements.
2. Make final changeover of permanent locks and deliver keys to Owner. Advise Owner's personnel of changeover in security provisions.
3. Complete startup and testing of systems and equipment.
4. Perform preventive maintenance on equipment used prior to Substantial Completion.
5. Instruct Owner's personnel in operation, adjustment, and maintenance of products, equipment, and systems. Submit demonstration and training video recordings specified in Section 017900 "Demonstration and Training."
6. Advise Owner of changeover in utility services.
7. Participate with Owner in conducting inspection and walkthrough with local emergency responders.
8. Terminate and remove temporary facilities from Project site, along with mockups, construction tools, and similar elements.
9. Complete final cleaning requirements.
10. Touch up paint and otherwise repair and restore marred exposed finishes to eliminate visual defects.

D. Inspection: Submit a written request for inspection to determine Substantial Completion a minimum of 10 days prior to date the Work will be completed and ready for final inspection and tests. On receipt of request, Architect will either proceed with inspection or notify Contractor of unfulfilled requirements. Architect will prepare the Certificate of Substantial Completion after inspection or will notify Contractor of items, either on Contractor's list or additional items identified by Architect, that must be completed or corrected before certificate will be issued.

1. Request reinspection when the Work identified in previous inspections as incomplete is completed or corrected.
2. Results of completed inspection will form the basis of requirements for Final Completion.

1.7 FINAL COMPLETION PROCEDURES

A. Submittals Prior to Final Completion: Before requesting final inspection for determining Final Completion, complete the following:

1. Submit a final Application for Payment in accordance with Section 012900 "Payment Procedures."
2. Certified List of Incomplete Items: Submit certified copy of Architect's Substantial Completion inspection list of items to be completed or corrected (punch list), endorsed and dated by Architect. Certified copy of the list will state that each item has been completed or otherwise resolved for acceptance.

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3. Certificate of Insurance: Submit evidence of final, continuing insurance coverage complying with insurance requirements.
4. Submit pest-control final inspection report.
5. Submit Final Completion photographic documentation.

B. Inspection: Submit a written request for final inspection to determine acceptance a minimum of 10 days prior to date the Work will be completed and ready for final inspection and tests. On receipt of request, Architect will either proceed with inspection or notify Contractor of unfulfilled requirements. Architect will prepare a final Certificate for Payment after inspection or will notify Contractor of construction that must be completed or corrected before certificate will be issued.

1. Request reinspection when the Work identified in previous inspections as incomplete is completed or corrected.

1.8 LIST OF INCOMPLETE ITEMS

A. Organization of List: Include name and identification of each space and area affected by construction operations for incomplete items and items needing correction including, if necessary, areas disturbed by Contractor that are outside the limits of construction.

1. Organize list of spaces in sequential order, starting with exterior areas first and proceeding from lowest floor to highest floor, listed by room or space number.
2. Organize items applying to each space by major element, including categories for ceilings, individual walls, floors, equipment, and building systems.
3. Include the following information at the top of each page:

a. Project name.
b. Date.
c. Name of Architect .
d. Name of Contractor.
e. Page number.

4. Submit list of incomplete items in the following format:

a. PDF Electronic File: Architect will return annotated file.
b. Web-Based Project Software Upload: Utilize software feature for creating and updating list of incomplete items (punch list).

1.9 SUBMITTAL OF PROJECT WARRANTIES

A. Time of Submittal: Submit written warranties on request of Architect for designated portions of the Work where warranties are indicated to commence on dates other than date of Substantial Completion, or when delay in submittal of warranties might limit Owner's rights under warranty.

B. Partial Occupancy: Submit properly executed warranties within 15 days of completion of designated portions of the Work that are completed and occupied or used by Owner during construction period by separate agreement with Contractor.

C. Organize warranty documents into an orderly sequence based on the table of contents of Project Manual.

D. Warranty Electronic File: Provide warranties and bonds in PDF format. Assemble complete warranty and bond submittal package into a single electronic PDF file with bookmarks enabling navigation to each item. Provide bookmarked table of contents at beginning of document.

1. Submit on digital media acceptable to Architect .

E. Warranties in Paper Form:

1. Bind warranties and bonds in heavy-duty, three-ring, vinyl-covered, loose-leaf binders, thickness as necessary to accommodate contents, and sized to receive **8-1/2-by-11-inch** paper.
2. Provide heavy paper dividers with plastic-covered tabs for each separate warranty. Mark tab to identify the product or installation. Provide a typed description of the product or installation,

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including the name of the product and the name, address, and telephone number of Installer.

3. Identify each binder on the front and spine with the typed or printed title "WARRANTIES," Project name, and name of Contractor.

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

PART 2 - PRODUCTS

2.1 MATERIALS

A. Cleaning Agents: Use cleaning materials and agents recommended by manufacturer or fabricator of the surface to be cleaned. Do not use cleaning agents that are potentially hazardous to health or property or that might damage finished surfaces.

PART 3 - EXECUTION

3.1 FINAL CLEANING

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

B. Cleaning: Employ experienced workers or professional cleaners for final cleaning. Clean each surface or unit to condition expected in an average commercial building cleaning and maintenance program. Comply with manufacturer's written instructions.

1. Complete the following cleaning operations before requesting inspection for certification of Substantial Completion for entire Project or for a designated portion of Project:

a. Clean Project site of rubbish, waste material, litter, and other foreign substances.
b. Sweep paved areas broom clean. Remove petrochemical spills, stains, and other foreign deposits.
c. Rake grounds that are not planted, mulched, or paved to a smooth, even-textured surface.
d. Remove tools, construction equipment, machinery, and surplus material from Project site.
e. Remove snow and ice to provide safe access to building.
f. Clean exposed exterior and interior hard-surfaced finishes to a dirt-free condition, free of stains, films, and similar foreign substances. Avoid disturbing natural weathering of exterior surfaces. Restore reflective surfaces to their original condition.
g. Remove debris and surface dust from limited-access spaces, including roofs, plenums, shafts, trenches, equipment vaults, manholes, attics, and similar spaces.
h. Clean flooring, removing debris, dirt, and staining; clean in accordance with manufacturer's instructions.
i. Vacuum and mop concrete.
j. Vacuum carpet and similar soft surfaces, removing debris and excess nap; clean in accordance with manufacturer's instructions if visible soil or stains remain.
k. Clean transparent materials, including mirrors and glass in doors and windows. Remove glazing compounds and other noticeable, vision-obscuring materials. Polish mirrors and glass, taking care not to scratch surfaces.
l. Remove labels that are not permanent.
m. Wipe surfaces of mechanical and electrical equipment , elevator equipment, and similar equipment. Remove excess lubrication, paint and mortar droppings, and other foreign substances.
n. Clean plumbing fixtures to a sanitary condition, free of stains, including stains resulting from water exposure.
o. Replace disposable air filters and clean permanent air filters. Clean exposed surfaces of diffusers, registers, and grills.
p. Clean ducts, blowers, and coils if units were operated without filters during construction or that display contamination with particulate matter on inspection.

1) Clean HVAC system in compliance with NADCA ACR. Provide written report on completion of cleaning.

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q. Clean luminaires, lamps, globes, and reflectors to function with full efficiency.
r. Clean strainers.
s. Leave Project clean and ready for occupancy.

C. Pest Control: Comply with pest control requirements in Section 015000 "Temporary Facilities and Controls." Prepare written report.

D. Construction Waste Disposal: Comply with waste-disposal requirements in Section 015000 "Temporary Facilities and Controls." Section 017419 "Construction Waste Management and Disposal."

3.2 CORRECTION OF THE WORK

A. Complete repair and restoration operations required by "Correction of the Work" Article in Section 017300 "Execution" before requesting inspection for determination of Substantial Completion.

END OF SECTION 01 77 00

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SECTION 01 78 23 - OPERATION AND MAINTENANCE DATA

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes: Administrative and procedural requirements for preparing operation and maintenance manuals, including the following:

1. Operation and maintenance documentation directory manuals.
2. Emergency manuals.
3. Systems and equipment operation manuals.
4. Systems and equipment maintenance manuals.
5. Product maintenance manuals.

B. Related Requirements:

1. Section 013300 "Submittal Procedures" for submitting copies of submittals for operation and maintenance manuals.

1.2 DEFINITIONS

A. System: An organized collection of parts, equipment, or subsystems united by regular interaction.

B. Subsystem: A portion of a system with characteristics similar to a system.

1.3 CLOSEOUT SUBMITTALS

A. Submit operation and maintenance manuals indicated. Provide content for each manual as specified in individual Specification Sections, and as reviewed and approved at the time of Section submittals. Submit reviewed manual content formatted and organized as required by this Section.

1. Architect will comment on whether content of operation and maintenance submittals is acceptable.
2. Where applicable, clarify and update reviewed manual content to correspond to revisions and field conditions.

B. Format: Submit operation and maintenance manuals in the following format:

1. Submit on digital media acceptable to Architect . Enable reviewer comments on draft submittals.

C. Initial Manual Submittal: Submit draft copy of each manual at least 30 days before commencing demonstration and training. Architect will comment on whether general scope and content of manual are acceptable.

D. Final Manual Submittal: Submit each manual in final form prior to requesting inspection for Substantial Completion and at least 15 days before commencing demonstration and training. Architect will return copy with comments.

1. Correct or revise each manual to comply with Architect's comments. Submit copies of each corrected manual within 15 days of receipt of Architect's comments and prior to commencing demonstration and training.

E. Comply with Section 017700 "Closeout Procedures" for schedule for submitting operation and maintenance documentation.

1.4 FORMAT OF OPERATION AND MAINTENANCE MANUALS

A. Manuals, Electronic Files: Submit manuals in the form of a multiple file composite electronic PDF file for each manual type required.

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1. Electronic Files: Use electronic files prepared by manufacturer where available. Where scanning of paper documents is required, configure scanned file for minimum readable file size.
2. File Names and Bookmarks: Bookmark individual documents based on file names. Name document files to correspond to system, subsystem, and equipment names used in manual directory and table of contents. Group documents for each system and subsystem into individual composite bookmarked files, then create composite manual, so that resulting bookmarks reflect the system, subsystem, and equipment names in a readily navigated file tree. Configure electronic manual to display bookmark panel on opening file.

1.5 REQUIREMENTS FOR EMERGENCY, OPERATION, AND MAINTENANCE MANUALS

A. Organization of Manuals: Unless otherwise indicated, organize each manual into a separate section for each system and subsystem, and a separate section for each piece of equipment not part of a system. Each manual to contain the following materials, in the order listed:

1. Title page.
2. Table of contents.
3. Manual contents.

B. Title Page: Include the following information:

1. Subject matter included in manual.
2. Name and address of Project.
3. Name and address of Owner.
4. Date of submittal.
5. Name and contact information for Contractor.
6. Name and contact information for Construction Manager.
7. Name and contact information for Architect.
8. Name and contact information for Commissioning Authority.
9. Names and contact information for major consultants to the Architect that designed the systems contained in the manuals.
10. Cross-reference to related systems in other operation and maintenance manuals.

C. Table of Contents: List each product included in manual, identified by product name, indexed to the content of the volume, and cross-referenced to Specification Section number in Project Manual.

1. If operation or maintenance documentation requires more than one volume to accommodate data, include comprehensive table of contents for all volumes in each volume of the set.

D. Manual Contents: Organize into sets of manageable size. Arrange contents alphabetically by system, subsystem, and equipment. If possible, assemble instructions for subsystems, equipment, and components of one system into a single binder.

E. Identification: In the documentation directory and in each operation and maintenance manual, identify each system, subsystem, and piece of equipment with same designation used in the Contract Documents. If no designation exists, assign a designation in accordance with ASHRAE Guideline 4, "Preparation of Operating and Maintenance Documentation for Building Systems."

1.6 OPERATION AND MAINTENANCE DOCUMENTATION DIRECTORY MANUAL

A. Operation and Maintenance Documentation Directory: Prepare a separate manual that provides an organized reference to emergency, operation, and maintenance manuals. List items and their location to facilitate ready access to desired information. Include the following:

1. List of Systems and Subsystems: List systems alphabetically. Include references to operation and maintenance manuals that contain information about each system.
2. List of Equipment: List equipment for each system, organized alphabetically by system. For pieces of equipment not part of system, list alphabetically in separate list.
3. Tables of Contents: Include a table of contents for each emergency, operation, and maintenance manual.

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1.7 EMERGENCY MANUALS

A. Emergency Manual: Assemble a complete set of emergency information indicating procedures for use by emergency personnel and by Owner's operating personnel for types of emergencies indicated.

B. Content: Organize manual into a separate section for each of the following:

1. Type of emergency.
2. Emergency instructions.
3. Emergency procedures.

C. Type of Emergency: Where applicable for each type of emergency indicated below, include instructions and procedures for each system, subsystem, piece of equipment, and component:

1. Fire.
2. Flood.
3. Gas leak.
4. Water leak.
5. Power failure.
6. Water outage.
7. System, subsystem, or equipment failure.
8. Chemical release or spill.

D. Emergency Instructions: Describe and explain warnings, trouble indications, error messages, and similar codes and signals. Include responsibilities of Owner's operating personnel for notification of Installer, supplier, and manufacturer to maintain warranties.

E. Emergency Procedures: Include the following, as applicable:

1. Instructions on stopping.
2. Shutdown instructions for each type of emergency.
3. Operating instructions for conditions outside normal operating limits.
4. Required sequences for electric or electronic systems.
5. Special operating instructions and procedures.

1.8 SYSTEMS AND EQUIPMENT OPERATION MANUALS

A. Systems and Equipment Operation Manual: Assemble a complete set of data indicating operation of each system, subsystem, and piece of equipment not part of a system. Include information required for daily operation and management, operating standards, and routine and special operating procedures.

1. Engage a factory-authorized service representative to assemble and prepare information for each system, subsystem, and piece of equipment not part of a system.
2. Prepare a separate manual for each system and subsystem, in the form of an instructional manual for use by Owner's operating personnel.

B. Content: In addition to requirements in this Section, include operation data required in individual Specification Sections and the following information:

1. System, subsystem, and equipment descriptions. Use designations for systems and equipment indicated on Contract Documents.
2. Performance and design criteria if Contractor has delegated design responsibility.
3. Operating standards.
4. Operating procedures.
5. Operating logs.
6. Wiring diagrams.
7. Control diagrams.
8. Piped system diagrams.
9. Precautions against improper use.
10. License requirements including inspection and renewal dates.

C. Descriptions: Include the following:

1. Product name and model number. Use designations for products indicated on Contract

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Documents.
2. Manufacturer's name.
3. Equipment identification with serial number of each component.
4. Equipment function.
5. Operating characteristics.
6. Limiting conditions.
7. Performance curves.
8. Engineering data and tests.
9. Complete nomenclature and number of replacement parts.

D. Operating Procedures: Include the following, as applicable:

1. Startup procedures.
2. Equipment or system break-in procedures.
3. Routine and normal operating instructions.
4. Regulation and control procedures.
5. Instructions on stopping.
6. Normal shutdown instructions.
7. Seasonal and weekend operating instructions.
8. Required sequences for electric or electronic systems.
9. Special operating instructions and procedures.

E. Systems and Equipment Controls: Describe the sequence of operation, and diagram controls as installed.

F. Piped Systems: Diagram piping as installed, and identify color coding where required for identification.

1.9 SYSTEMS AND EQUIPMENT MAINTENANCE MANUALS

A. Systems and Equipment Maintenance Manuals: Assemble a complete set of data indicating maintenance of each system, subsystem, and piece of equipment not part of a system. Include manufacturers' maintenance documentation, preventive maintenance procedures and frequency, repair procedures, wiring and systems diagrams, lists of spare parts, and warranty information.

1. Engage a factory-authorized service representative to assemble and prepare information for each system, subsystem, and piece of equipment not part of a system.
2. Prepare a separate manual for each system and subsystem, in the form of an instructional manual for use by Owner's operating personnel.

B. Content: For each system, subsystem, and piece of equipment not part of a system, include source information, manufacturers' maintenance documentation, maintenance procedures, maintenance and service schedules, spare parts list and source information, maintenance service contracts, and warranties and bonds as described below.

C. Source Information: List each system, subsystem, and piece of equipment included in manual, identified by product name and arranged to match manual's table of contents. For each product, list name, address, and telephone number of Installer or supplier and maintenance service agent, and cross-reference Specification Section number and title in Project Manual and drawing or schedule designation or identifier where applicable.

D. Manufacturers' Maintenance Documentation: Include the following information for each component part or piece of equipment:

1. Standard maintenance instructions and bulletins; include only sheets pertinent to product or component installed. Mark each sheet to identify each product or component incorporated into the Work. If data include more than one item in a tabular format, identify each item using appropriate references from the Contract Documents. Identify data applicable to the Work and delete references to information not applicable.

a. Prepare supplementary text if manufacturers' standard printed data are not available and where the information is necessary for proper operation and maintenance of equipment or systems.

2. Drawings, diagrams, and instructions required for maintenance, including disassembly and

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component removal, replacement, and assembly.
3. Identification and nomenclature of parts and components.
4. List of items recommended to be stocked as spare parts.

E. Maintenance Procedures: Include the following information and items that detail essential maintenance procedures:

1. Test and inspection instructions.
2. Troubleshooting guide.
3. Precautions against improper maintenance.
4. Disassembly; component removal, repair, and replacement; and reassembly instructions.
5. Aligning, adjusting, and checking instructions.
6. Demonstration and training video recording, if available.

F. Maintenance and Service Schedules: Include service and lubrication requirements, list of required lubricants for equipment, and separate schedules for preventive and routine maintenance and service with standard time allotment.

1. Scheduled Maintenance and Service: Tabulate actions for daily, weekly, monthly, quarterly, semiannual, and annual frequencies.
2. Maintenance and Service Record: Include manufacturers' forms for recording maintenance.

G. Spare Parts List and Source Information: Include lists of replacement and repair parts, with parts identified and cross-referenced to manufacturers' maintenance documentation and local sources of maintenance materials and related services.

H. Maintenance Service Contracts: Include copies of maintenance agreements with name and telephone number of service agent.

I. Warranties and Bonds: Include copies of warranties and bonds and lists of circumstances and conditions that would affect validity of warranties or bonds.

1. Include procedures to follow and required notifications for warranty claims.

J. Drawings: Prepare drawings supplementing manufacturers' printed data to illustrate the relationship of component parts of equipment and systems and to illustrate control sequence and flow diagrams. Coordinate these drawings with information contained in record Drawings to ensure correct illustration of completed installation.

1. Do not use original project record documents as part of maintenance manuals.

1.10 PRODUCT MAINTENANCE MANUALS

A. Product Maintenance Manual: Assemble a complete set of maintenance data indicating care and maintenance of each product, material, and finish incorporated into the Work.

B. Content: Organize manual into a separate section for each product, material, and finish. Include source information, product information, maintenance procedures, repair materials and sources, and warranties and bonds, as described below.

C. Source Information: List each product included in manual, identified by product name and arranged to match manual's table of contents. For each product, list name, address, and telephone number of Installer or supplier and maintenance service agent, and cross-reference Specification Section number and title in Project Manual and drawing or schedule designation or identifier where applicable.

D. Product Information: Include the following, as applicable:

1. Product name and model number.
2. Manufacturer's name.
3. Color, pattern, and texture.
4. Material and chemical composition.
5. Reordering information for specially manufactured products.

E. Maintenance Procedures: Include manufacturer's written recommendations and the following:

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1. Inspection procedures.
2. Types of cleaning agents to be used and methods of cleaning.
3. List of cleaning agents and methods of cleaning detrimental to product.
4. Schedule for routine cleaning and maintenance.
5. Repair instructions.

F. Repair Materials and Sources: Include lists of materials and local sources of materials and related services.

G. Warranties and Bonds: Include copies of warranties and bonds and lists of circumstances and conditions that would affect validity of warranties or bonds.

1. Include procedures to follow and required notifications for warranty claims.

PART 2 - PRODUCTS (Not Used)
PART 3 - EXECUTION (Not Used)

END OF SECTION 01 78 23

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SECTION 01 78 39 - PROJECT RECORD DOCUMENTS

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes administrative and procedural requirements for Project Record Documents, including the following:

1. Record Drawings.
2. Record specifications.
3. Record Product Data.
4. Miscellaneous record submittals.

B. Related Requirements:

1. Section 017300 "Execution" for final property survey.
2. Section 017700 "Closeout Procedures" for general closeout procedures.
3. Section 017823 "Operation and Maintenance Data" for operation and maintenance manual requirements.

1.2 CLOSEOUT SUBMITTALS

A. Record Drawings: Comply with the following:

1. Number of Copies: Submit one set(s) of marked-up record prints.
2. Number of Copies: Submit copies of Record Drawings as follows:

a. Initial Submittal:

1) Submit PDF electronic files of scanned record prints and one set(s) of file prints.
2) Submit Record Digital Data Files and 0 set(s) of plots.
3) Architect will indicate whether general scope of changes, additional information recorded, and quality of drafting are acceptable.

B. Record Specifications: Submit annotated PDF electronic files of Project's Specifications, including addenda and Contract modifications.

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

1. Where record Product Data are required as part of operation and maintenance manuals, submit duplicate marked-up Product Data as a component of manual.

D. Miscellaneous Record Submittals: See other Specification Sections for miscellaneous record-keeping requirements and submittals in connection with various construction activities. Submit annotated PDF electronic files and directories of each submittal.

E. Reports: Submit written report indicating items incorporated into Project Record Documents concurrent with progress of the Work, including revisions, concealed conditions, field changes, product selections, and other notations incorporated.

1.3 RECORD DRAWINGS

A. Record Prints: Maintain one set of marked-up paper copies of the Contract Drawings and Shop Drawings, incorporating new and revised drawings as modifications are issued.

1. Preparation: Mark record prints to show the actual installation, where installation varies from that shown originally. Require individual or entity who obtained record data, whether individual or entity is Installer, subcontractor, or similar entity, to provide information for preparation of corresponding marked-up record prints.

a. Give particular attention to information on concealed elements that would be difficult to

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identify or measure and record later.
b. Accurately record information in an acceptable drawing technique.
c. Record data as soon as possible after obtaining it.
d. Record and check the markup before enclosing concealed installations.
e. Cross-reference record prints to corresponding photographic documentation.

2. Content: Types of items requiring marking include, but are not limited to, the following:

a. Dimensional changes to Drawings.
b. Revisions to details shown on Drawings.
c. Depths of foundations.
d. Locations and depths of underground utilities.
e. Revisions to routing of piping and conduits.
f. Revisions to electrical circuitry.
g. Actual equipment locations.
h. Duct size and routing.
i. Locations of concealed internal utilities.
j. Changes made by Change Order or Construction Change Directive.
k. Changes made following Architect's written orders.
l. Details not on the original Contract Drawings.
m. Field records for variable and concealed conditions.
n. Record information on the Work that is shown only schematically.

3. Mark the Contract Drawings and Shop Drawings completely and accurately. Use personnel proficient at recording graphic information in production of marked-up record prints.
4. Mark record prints with erasable, red-colored pencil. Use other colors to distinguish between changes for different categories of the Work at same location.
5. Mark important additional information that was either shown schematically or omitted from original Drawings.
6. Note Construction Change Directive numbers, alternate numbers, Change Order numbers, and similar identification, where applicable.

B. Record Digital Data Files: Immediately before inspection for Certificate of Substantial Completion, review marked-up record prints with Architect . When authorized, prepare a full set of corrected digital data files of the Contract Drawings, as follows:

1. Format: Annotated PDF electronic file .
2. Incorporate changes and additional information previously marked on record prints. Delete, redraw, and add details and notations where applicable.
3. Refer instances of uncertainty to Architect for resolution.
4. Architect will furnish Contractor with one set of digital data files of the Contract Drawings for use in recording information.

a. See Section 013100 "Project Management and Coordination" for requirements related to use of Architect's digital data files.
b. Architect will provide data file layer information. Record markups in separate layers.

C. Format: Identify and date each Record Drawing; include the designation "PROJECT RECORD DRAWING" in a prominent location.

1. Record Prints: Organize record prints into manageable sets. Bind each set with durable paper cover sheets. Include identification on cover sheets.
2. Format: Annotated PDF electronic file .
3. Record Digital Data Files: Organize digital data information into separate electronic files that correspond to each sheet of the Contract Drawings. Name each file with the sheet identification. Include identification in each digital data file.
4. Identification: As follows:

a. Project name.
b. Date.
c. Designation "PROJECT RECORD DRAWINGS."
d. Name of Architect .
e. Name of Contractor.

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1.4 RECORD SPECIFICATIONS

A. Preparation: Mark Specifications to indicate the actual product installation, where installation varies from that indicated in Specifications, addenda, and Contract modifications.

1. Give particular attention to information on concealed products and installations that cannot be readily identified and recorded later.
2. Mark copy with the proprietary name and model number of products, materials, and equipment furnished, including substitutions and product options selected.
3. Record the name of manufacturer, supplier, Installer, and other information necessary to provide a record of selections made.
4. For each principal product, indicate whether Record Product Data has been submitted in operation and maintenance manuals instead of submitted as Record Product Data.
5. Note related Change Orders and Record Drawings where applicable.

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

1.5 RECORD PRODUCT DATA

A. Recording: Maintain one copy of each submittal during the construction period for Project Record Document purposes. Post changes and revisions to Project Record Documents as they occur; do not wait until end of Project.

B. Preparation: Mark Product Data to indicate the actual product installation where installation varies substantially from that indicated in Product Data submittal.

1. Give particular attention to information on concealed products and installations that cannot be readily identified and recorded later.
2. Include significant changes in the product delivered to Project site and changes in manufacturer's written instructions for installation.
3. Note related Change Orders and Record Drawings where applicable.

C. Format: Submit Record Product Data as annotated PDF electronic file .

1. Include Record Product Data directory organized by Specification Section number and title, electronically linked to each item of Record Product Data.

1.6 MISCELLANEOUS RECORD SUBMITTALS

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

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

1. Include miscellaneous record submittals directory organized by Specification Section number and title, electronically linked to each item of miscellaneous record submittals.

1.7 MAINTENANCE OF RECORD DOCUMENTS

A. Maintenance of Record Documents: Store Record Documents in the field office apart from the Contract Documents used for construction. Do not use Project Record Documents for construction purposes. Maintain Record Documents in good order and in a clean, dry, legible condition, protected from deterioration and loss. Provide access to Project Record Documents for Architect's reference during normal working hours.

PART 2 - PRODUCTS (Not Used)
PART 3 - EXECUTION (Not Used)

END OF SECTION 01 78 39

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SECTION 01 78 46 - ATTIC STOCK

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

B. All sections of the project manual are directly applicable to this specification section. Should a conflict arise between specification sections or between specifications and drawings and/or code requirements, the contractor shall notify the Architect/Engineer of the conflict in writing. If direction is not provided prior to the submission of the bid, the contractor shall price the more extensive system.

1.2 SUMMARY

A. Section Includes:

1. Attic Stock
2. Spare Parts

1.3 DEFINITIONS

A. Acceptance: The transfer of goods from an outside entity to the owner that has been documented and acknowledged by both parties in writing.

B. Appropriate Credit: Amount of compensation agreed to by both parties. This value should be the vendor documented purchase price of the material, including tax, shipping, and contractor markup.

C. Attic Stock: Additional material and accessories designated in the design specifications, including but not limited to ceiling tile, fire alarm devices, door hardware, etc.

D. OEM: Original Equipment Manufacturer.

E. Perishable Items: Items such as paint, adhesives, and other items with a finite shelf life.

F. Spare Parts: Parts or equipment components that are included in the purchase of the original equipment, and are provided by the OEM for use by the owner.

1.4 ACTION SUBMITTALS

A. Product Data: For each item provided.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Prepare items for storage as follows:

1. Items shall be delivered in undamaged, original packing.
2. Item description and quantity shall be clearly marked on a visible surface of the packaging.
3. Include item technical documentation.

PART 2 - PRODUCTS

2.1 ATTIC STOCK

A. Tiling

1. Section 093013 – Tiling
2. 3% of required quantity for each color or type.

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B. Acoustic Tile Ceilings

1. Section 095123 – Acoustic Tile Ceiling
2. 5% of required quantity

C. Resilient Base and Accessories

1. Section 096513 – Resilient Base and Accessories
2. 5% of required quantity for each color or type.

D. Flooring

1. Section 096519 – Resilient Tile and Sheet Flooring
2. 5% of required quantity for each color or type.

E. Paint

1. Section 099113 – Exterior Painting
2. Section 099123 – Interior Painting
3. 10 Gallons per color of paint.

F. Carpeting

1. Section 096813 – Tile Carpeting
2. 5% of required quantity for each color or type.

2.2 SPARE PARTS

A. The Owner is responsible for the acceptance and storage of spare parts. The supervisor has final authority in determining if an item should be accepted.

B. Items included with the purchase of materials or equipment that are considered spare or replacement parts are the property of the Owner, and shall be submitted to the area for acceptance and storage.

C. Installation aids, transportation tools and all items that are not deemed as spare parts shall be disposed of per the Section 017419 Construction Waste Management and Disposal, or may be retained by the contractor.

PART 3 - EXECUTION

3.1 DELIVERY

A. Material shall be delivered directly to an approved, designated storage area, confirmed prior to delivery. Material acceptance must be verified in writing by the requesting party, typically the Owner.

3.2 STORAGE

A. Mechanical rooms, electrical rooms, telecom, and other service areas are not to be used as storage or staging areas unless prior written approval is obtained from the Owner.

B. Designated storage areas in mechanical spaces must be clearly identified prior to delivery.

END OF SECTION 01 78 46

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SECTION 01 79 00 - DEMONSTRATION AND TRAINING

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes administrative and procedural requirements for instructing Owner's personnel, including the following:

1. Instruction in operation and maintenance of systems, subsystems, and equipment.
2. Demonstration and training video recordings.

1.2 INFORMATIONAL SUBMITTALS

A. Instruction Program: Submit outline of instructional program for demonstration and training, including a list of training modules and a schedule of proposed dates, times, length of instruction time, and instructors' names for each training module. Include learning objective and outline for each training module.

1. Indicate proposed training modules using manufacturer-produced demonstration and training video recordings for systems, equipment, and products in lieu of video recording of live instructional module.

B. Attendance Record: For each training module, submit list of participants and length of instruction time.

C. Evaluations: For each participant and for each training module, submit results and documentation of performance-based test.

1.3 CLOSEOUT SUBMITTALS

A. Demonstration and Training Video Recordings: Submit two copies within seven days of end of each training module.

1. Identification: On each copy, provide an applied label with the following information:

a. Name of Project.
b. Name and address of videographer.
c. Name of Architect.
d. Name of Construction Manager.
e. Name of Contractor.
f. Date of video recording.

2. Transcript:

a. Prepared and bound in format matching operation and maintenance manuals. Mark appropriate identification on front and spine of each binder. Include a cover sheet with same label information as the corresponding video recording. Include name of Project and date of video recording on each page.
b. Prepared in PDF electronic format. Include a cover sheet with same label information as the corresponding video recording and a table of contents with links to corresponding training components. Include name of Project and date of video recording on each page.

3. At completion of training, submit complete training manual(s) for Owner's use prepared in same PDF file format required for operation and maintenance manuals specified in Section 017823 "Operation and Maintenance Data."

1.4 QUALITY ASSURANCE

A. Facilitator Qualifications: A firm or individual experienced in training or educating maintenance personnel in a training program similar in content and extent to that indicated for this Project, and whose work has resulted in training or education with a record of successful learning performance.

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B. Instructor Qualifications: A factory-authorized service representative, complying with requirements in Section 014000 "Quality Requirements," experienced in operation and maintenance procedures and training.

C. Videographer Qualifications: A professional videographer who is experienced photographing demonstration and training events similar to those required.

D. Preinstruction Conference: Conduct conference at Project site to comply with requirements in Section 013100 "Project Management and Coordination." Review methods and procedures related to demonstration and training including, but not limited to, the following:

1. Inspect and discuss locations and other facilities required for instruction.
2. Review and finalize instruction schedule and verify availability of educational materials, instructors' personnel, audiovisual equipment, and facilities needed to avoid delays.
3. Review required content of instruction.
4. For instruction that must occur outside, review weather and forecasted weather conditions and procedures to follow if conditions are unfavorable.

1.5 COORDINATION

A. Coordinate instruction schedule with Owner's operations. Adjust schedule as required to minimize disrupting Owner's operations and to ensure availability of Owner's personnel.

B. Coordinate instructors, including providing notification of dates, times, length of instruction time, and course content.

C. Coordinate content of training modules with content of approved emergency, operation, and maintenance manuals. Do not submit instruction program until operation and maintenance data have been reviewed and approved by Architect.

1.6 INSTRUCTION PROGRAM

A. Program Structure: Develop an instruction program that includes individual training modules for each system and for equipment not part of a system, as required by individual Specification Sections.

B. Training Modules: Develop a learning objective and teaching outline for each module. Include a description of specific skills and knowledge that participant is expected to master. For each module, include instruction for the following as applicable to the system, equipment, or component:

1. Basis of System Design, Operational Requirements, and Criteria: Include the following:

   a. System, subsystem, and equipment descriptions.
   b. Performance and design criteria if Contractor is delegated design responsibility.
   c. Operating standards.
   d. Regulatory requirements.
   e. Equipment function.
   f. Operating characteristics.
   g. Limiting conditions.
   h. Performance curves.

2. Documentation: Review the following items in detail:

   a. Emergency manuals.
   b. Systems and equipment operation manuals.
   c. Systems and equipment maintenance manuals.
   d. Product maintenance manuals.
   e. Project Record Documents.
   f. Identification systems.
   g. Warranties and bonds.
   h. Maintenance service agreements and similar continuing commitments.

3. Emergencies: Include the following, as applicable:

   a. Instructions on meaning of warnings, trouble indications, and error messages.

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b. Instructions on stopping.
c. Shutdown instructions for each type of emergency.
d. Operating instructions for conditions outside of normal operating limits.
e. Sequences for electric or electronic systems.
f. Special operating instructions and procedures.

4. Operations: Include the following, as applicable:

a. Startup procedures.
b. Equipment or system break-in procedures.
c. Routine and normal operating instructions.
d. Regulation and control procedures.
e. Control sequences.
f. Safety procedures.
g. Instructions on stopping.
h. Normal shutdown instructions.
i. Operating procedures for emergencies.
j. Operating procedures for system, subsystem, or equipment failure.
k. Seasonal and weekend operating instructions.
l. Required sequences for electric or electronic systems.
m. Special operating instructions and procedures.

5. Adjustments: Include the following:

a. Alignments.
b. Checking adjustments.
c. Noise and vibration adjustments.
d. Economy and efficiency adjustments.

6. Troubleshooting: Include the following:

a. Diagnostic instructions.
b. Test and inspection procedures.

7. Maintenance: Include the following:

a. Inspection procedures.
b. Types of cleaning agents to be used and methods of cleaning.
c. List of cleaning agents and methods of cleaning detrimental to product.
d. Procedures for routine cleaning.
e. Procedures for preventive maintenance.
f. Procedures for routine maintenance.
g. Instruction on use of special tools.

8. Repairs: Include the following:

a. Diagnosis instructions.
b. Repair instructions.
c. Disassembly; component removal, repair, and replacement; and reassembly instructions.
d. Instructions for identifying parts and components.
e. Review of spare parts needed for operation and maintenance.

1.7 PREPARATION

A. Assemble educational materials necessary for instruction, including documentation and training module. Assemble training modules into a training manual organized in coordination with requirements in Section 017823 "Operation and Maintenance Data."

B. Set up instructional equipment at instruction location.

1.8 INSTRUCTION

A. Facilitator: Engage a qualified facilitator to prepare instruction program and training modules, to

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coordinate instructors, and to coordinate between Contractor and Owner for number of participants, instruction times, and location.

B. Engage qualified instructors to instruct Owner's personnel to adjust, operate, and maintain systems, subsystems, and equipment not part of a system.

1. Architect will furnish an instructor to describe basis of system design, operational requirements, criteria, and regulatory requirements.
2. Owner will furnish an instructor to describe Owner's operational philosophy.
3. Owner will furnish Contractor with names and positions of participants.

C. Scheduling: Provide instruction at mutually agreed-on times. For equipment that requires seasonal operation, provide similar instruction at start of each season.

1. Schedule training with Owner with at least seven days' advance notice.

D. Training Location and Reference Material: Conduct training on-site in the completed and fully operational facility using the actual equipment in-place. Conduct training using final operation and maintenance data submittals.

E. Evaluation: At conclusion of each training module, assess and document each participant's mastery of module by use of a demonstration performance-based test.

F. Cleanup: Collect used and leftover educational materials and give to Owner . Remove instructional equipment. Restore systems and equipment to condition existing before initial training use.

1.9 DEMONSTRATION AND TRAINING VIDEO RECORDINGS

A. General: Engage a qualified commercial videographer to record demonstration and training video recordings. Record each training module separately. Include classroom instructions and demonstrations, board diagrams, and other visual aids, but not student practice.

1. At beginning of each training module, record each chart containing learning objective and lesson outline.

B. Digital Video Recordings: Provide high-resolution, digital video in MPEG format, produced by a digital camera with minimum sensor resolution of 12 megapixels and capable of recording in full HD mode .

1. Submit video recordings by uploading to web-based Project software site .
2. File Hierarchy: Organize folder structure and file locations in accordance with Project Manual table of contents. Provide complete screen-based menu.
3. File Names: Utilize file names based on name of equipment generally described in video segment, as identified in Project specifications.
4. Contractor and Installer Contact File: Using appropriate software, create a file for inclusion on the equipment demonstration and training recording that describes the following for each Contractor involved on the Project, arranged in accordance with Project Manual table of contents:

   a. Name of Contractor/Installer.
   b. Business address.
   c. Business phone number.
   d. Point of contact.
   e. Email address.

C. Recording: Mount camera on tripod before starting recording, unless otherwise necessary to adequately cover area of demonstration and training. Display continuous running time.

1. Film training session(s) in segments not to exceed 15 minutes.

   a. Produce segments to present a single significant piece of equipment per segment.
   b. Organize segments with multiple pieces of equipment to follow order of Project Manual table of contents.
   c. Where a training session on a particular piece of equipment exceeds 15 minutes, stop filming and pause training session. Begin training session again upon commencement of new filming segment.

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D. Light Levels: Verify light levels are adequate to properly light equipment. Verify equipment markings are clearly visible prior to recording.

1. Furnish additional portable lighting as required.

E. Narration: Describe scenes on video recording by audio narration by microphone while video recording is recorded. Include description of items being viewed.

F. Transcript: Provide a transcript of the narration. Display images and running time captured from videotape opposite the corresponding narration segment.

G. Preproduced Video Recordings: Provide video recordings used as a component of training modules in same format as recordings of live training.

PART 2 - PRODUCTS (Not Used)
PART 3 - EXECUTION (Not Used)

END OF SECTION 01 79 00

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SECTION 02 41 19 - SELECTIVE DEMOLITION

PART 1 - GENERAL

1.1 SUMMARY

A. The Work of this Section Includes:

1. Demolition and removal of selected portions of exterior or interior of building or structure and site elements.
2. Removal and salvage of existing items for delivery to Owner and removal of existing items for reinstallation.

B. Related Requirements:

1. Section 011000 "Summary" for restrictions on use of the premises, Owner-occupancy requirements, and phasing requirements.
2. Section 017300 "Execution" for cutting and patching procedures.

1.2 DEFINITIONS

A. Remove: Detach items from existing construction and legally dispose of off-site unless indicated to be removed and salvaged or removed and reinstalled.

B. Remove and Salvage: Detach items from existing construction, in a manner to prevent damage, and deliver to Owner as indicated.

C. Remove and Reinstall: Detach items from existing construction, in a manner to prevent damage; prepare for reuse; and reinstall where indicated.

D. Existing to Remain: Existing items of construction that are not to be removed.

1.3 MATERIALS OWNERSHIP

A. Unless otherwise indicated, demolition waste becomes property of Contractor.

B. Historic items, relics, antiques, and similar objects including, but not limited to, cornerstones and their contents, commemorative plaques and tablets, and other items of interest or value to Owner that may be uncovered during demolition remain the property of Owner.

1. Carefully salvage in a manner to prevent damage and promptly return to Owner.

1.4 COORDINATION

A. Arrange selective demolition schedule so as not to interfere with Owner's operations.

B. Coordinate selective demolition with all disciplines, including structural, mechanical, electrical, and plumbing drawings and requirements.

C. Review original structural documents where available to understand existing load paths and construction.

D. Do not proceed with demolition that may compromise structural integrity without approval from Architect and Structural Engineer.

E. Coordinate extent of demolition with requirements of new construction to ensure proper installation of new Work.

1.5 PREINSTALLATION MEETINGS

A. Predemolition Conference: Conduct conference at Project site.

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1. Inspect and discuss condition of construction to be selectively demolished.
2. Review structural load limitations of existing structure.
3. Review and finalize selective demolition schedule and verify availability of demolition personnel, equipment, and facilities needed to make progress and avoid delays.
4. Review requirements of work performed by other trades that rely on substrates exposed by selective demolition operations.
5. Review areas where existing construction is to remain and requires protection.
6. Review and finalize protection requirements.
7. Review procedures for noise control and dust control.
8. Review storage, protection, and accounting for items to be removed for salvage or reinstallation.

1.6 INFORMATIONAL SUBMITTALS

A. Qualification Statements: For refrigerant recovery technician.

B. Survey of Existing Conditions: Submit survey.

C. Proposed Protection Measures: Submit report, including Drawings, that indicates the measures proposed for protecting individuals and property , for environmental protection , for dust control and , for noise control. Indicate proposed locations and construction of barriers.

D. Schedule of Selective Demolition Activities: Indicate the following:

1. Detailed sequence of selective demolition and removal work, with starting and ending dates for each activity. Ensure Owner's on-site operations are uninterrupted.
2. Temporary interruption of utility services. Indicate how long utility services will be interrupted.
3. Coordination for shutoff, capping, and continuation of utility services.
4. Use of elevator and stairs.
5. Coordination of Owner's continuing occupancy of portions of existing building and of Owner's partial occupancy of completed Work.

E. Statement of Refrigerant Recovery: Signed by refrigerant recovery technician responsible for recovering refrigerant, stating that all refrigerant that was present was recovered and that recovery was performed in accordance with EPA regulations. Include name and address of technician and date refrigerant was recovered.

F. Warranties: Documentation indicating that existing warranties are still in effect after completion of selective demolition.

1.7 CLOSEOUT SUBMITTALS

A. Inventory: Submit a list of items that have been removed and salvaged.

1.8 QUALITY ASSURANCE

A. Refrigerant Recovery Technician Qualifications: Universal certified by an EPA-approved certification program.

1.9 FIELD CONDITIONS

A. General Existing Conditions Notes:

1. Contractor shall examine, verify, and document existing conditions affecting the Work prior to starting demolition.
2. Field verify dimensions, extents, and conditions of construction to be removed or affected.
3. Notify Architect of discrepancies between existing conditions and the Contract Documents before proceeding.
4. If unanticipated or concealed conditions are encountered, immediately stop work in affected area and notify Architect for direction.

B. Conditions existing at time of inspection for bidding purpose will be maintained by Owner as far as

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practical.

1. Before selective demolition, Owner will remove the following items:

   a. Furniture and other non-fixed items.

C. Notify Architect of discrepancies between existing conditions and Drawings before proceeding with selective demolition.

D. Hazardous Materials:

1. It is not expected that hazardous materials will be encountered in the Work.

   a. Hazardous materials will be removed by Owner before start of the Work.
   b. If materials suspected of containing hazardous materials are encountered, do not disturb; immediately notify Architect and Owner. Hazardous materials will be removed by Owner under a separate contract.

E. Historic Areas: Demolition and hauling equipment and other materials to be of sizes that clear surfaces within historic spaces, areas, rooms, and openings, including temporary protection, by 12 inches or more.

F. On-site sale of removed items or materials is not permitted.

1.10 WARRANTY

A. Existing Warranties: Remove, replace, patch, and repair materials and surfaces cut or damaged during selective demolition, by methods and with materials and using approved contractors so as not to void existing warranties. Notify warrantor before proceeding. Existing warranties include the following:

1. <**Insert warranted system**>.

B. Notify warrantor on completion of selective demolition, and obtain documentation verifying that existing system has been inspected and warranty remains in effect. Submit documentation at Project closeout.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Regulatory Requirements: Comply with governing EPA notification regulations before beginning selective demolition. Comply with hauling and disposal regulations of authorities having jurisdiction.

B. Standards: Comply with ANSI/ASSP A10.6 and NFPA 241.

C. Sustainable Design Requirements for Building Reuse:

1. Maintain the existing building structure, envelope, and interior nonstructural elements of an abandoned or blighted building. Do not demolish such existing construction beyond indicated limits.
2. Maintain the existing building structural systems where indicated to remain. Do not demolish such existing construction beyond indicated limits.
3. Maintain the existing interior ceilings, interior partitions, and/or demountable walls where indicated to remain. Do not demolish such existing construction beyond indicated limits.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verify that utilities have been disconnected and capped before starting selective demolition operations.

B. Review Project Record Documents of existing construction or other existing condition and hazardous material information provided by Owner. Owner does not guarantee that existing conditions are same as those indicated in Project Record Documents.

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C. Verify that hazardous materials have been remediated before proceeding with building demolition operations.

D. Survey of Existing Conditions: Record existing conditions by use of preconstruction photographs or video , measured drawings. Comply with Section 013233 "Photographic Documentation."

1. Inventory and record the condition of items to be removed for salvage or reinstallation. Photograph or video conditions that might be misconstrued as damage caused by removal.
2. Photograph or video existing conditions of adjoining construction including finish surfaces, that might be misconstrued as damage caused by selective demolition operations or removal of items for salvage or reinstallation.

3.2 PREPARATION

A. Temporary Shoring: Design, provide, and maintain shoring, bracing, and structural supports as required to preserve stability and prevent movement, settlement, or collapse of construction and finishes to remain, and to prevent unexpected or uncontrolled movement or collapse of construction being demolished.

1. Strengthen or add new supports when required during progress of selective demolition.

B. Temporary Protection: Provide temporary barricades and other protection required to prevent injury to people and damage to adjacent buildings and facilities to remain.

1. Provide protection to ensure safe passage of people around selective demolition area and to and from occupied portions of building.
2. Provide temporary weather protection, during interval between selective demolition of existing construction on exterior surfaces and new construction, to prevent water leakage and damage to structure and interior areas.
3. Protect walls, ceilings, floors, and other existing finish work that are to remain or that are exposed during selective demolition operations.
4. Cover and protect furniture, furnishings, and equipment that have not been removed.
5. Comply with requirements for temporary enclosures, dust control, heating, and cooling specified in Section 015000 "Temporary Facilities and Controls."

C. Existing Items to Remain: Protect construction indicated to remain against damage and soiling during selective demolition. When permitted by Architect, items may be removed to a suitable, protected storage location and cleaned and reinstalled in their original locations after selective demolition operations are complete.

D. Refrigerant: Before starting demolition, remove refrigerant from mechanical equipment in accordance with 40 CFR 82 and regulations of authorities having jurisdiction.

3.3 UTILITY SERVICES AND BUILDING SYSTEMS

A. Existing Services/Systems to Remain: Maintain utilities and building systems and equipment to remain and protect against damage during selective demolition operations.

1. Maintain fire-protection facilities in service during selective demolition operations.

B. Existing Services/Systems to Be Removed, Relocated, or Abandoned: Locate, identify, disconnect, and seal or cap off utilities and building systems serving areas to be selectively demolished.

1. Arrange to shut off utilities with utility companies.
2. If disconnection of utilities and building systems will affect adjacent occupied parts of the building, provide temporary services/systems that bypass area of selective demolition and that maintain continuity of services/systems to those parts of the building.
3. Demolish and remove existing building systems, equipment, and components indicated on Drawings to be removed.

   a. Piping to Be Removed: Remove portion of piping indicated to be removed and cap or plug remaining piping with same or compatible piping material.
   b. Ducts to Be Removed: Remove portion of ducts indicated to be removed and plug remaining ducts with same or compatible ductwork material.

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c. Equipment to Be Removed: Disconnect and cap services and remove equipment and components.

4. Abandon existing building systems, equipment, and components indicated on Drawings to be abandoned in place.

   a. Piping to Be Abandoned in Place: Drain piping and cap or plug piping with same or compatible piping material and leave in place.
   b. Ducts to Be Abandoned in Place: Cap or plug ducts with same or compatible ductwork material and leave in place.

5. Remove and reinstall/salvage existing building systems, equipment, and components indicated on drawings to be removed and reinstalled or removed and salvaged:

   a. Equipment to Be Removed and Reinstalled: Disconnect and cap services and remove, clean, and store equipment and components; when appropriate, reinstall, reconnect, and make equipment operational.
   b. Equipment to Be Removed and Salvaged: Disconnect and cap services and remove equipment and components and deliver to Owner.

3.4 SALVAGE/REINSTALL

A. Removed and Salvaged Items:

1. Clean salvaged items.
2. Pack or crate items after cleaning. Identify contents of containers with label indicating elements, date of removal, quantity, and location where removed.
3. Store items in a secure area until delivery to Owner.
4. Transport items to Owner's storage area designated by Owner.
5. Protect items from damage during transport and storage.

B. Removed and Reinstalled Items:

1. Clean and repair items to functional condition adequate for intended reuse.
2. Pack or crate items after cleaning and repairing. Identify contents of containers.
3. Protect items from damage during transport and storage.
4. Reinstall items in locations indicated. Comply with installation requirements for new materials and equipment. Provide connections, supports, and miscellaneous materials necessary to make item functional for use indicated.

3.5 SELECTIVE DEMOLITION, GENERAL

A. GENERAL DEMOLITION NOTES:

1. Demolition drawings indicate general scope of work only.
2. Remove items indicated on Drawings, including but not limited to partitions, ceilings, doors and frames, equipment, casework, accessories, and slab-on-grade where shown.
3. Where demolition is indicated graphically (e.g., dashed lines, poche), remove construction accordingly.
4. Perform additional demolition not explicitly shown but required to accommodate new construction.
5. Absence of specific demolition indications does not relieve Contractor of responsibility to remove items necessary to complete the Work.
6. Coordinate unclear conditions with Architect prior to proceeding.

B. Work in Historic Areas: Selective demolition may be performed only in areas of Project that are not designated as historic. In historic spaces, areas, and rooms, or on historic surfaces, the terms "demolish" or "remove" to mean historic "removal" or "dismantling" as specified in Section 024296 "Historic Removal and Dismantling."

C. General: Demolish and remove existing construction only to extent required by new construction and as indicated. Use methods required to complete the Work within limitations of governing regulations and as follows:

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1. Proceed with selective demolition systematically, from higher to lower level. Complete selective demolition operations above each floor or tier before disturbing supporting members on the next lower level.
2. Neatly cut openings and holes plumb, square, and true to dimensions required. Use cutting methods least likely to damage construction to remain or adjoining construction. Use hand tools or small power tools designed for sawing or grinding, not hammering and chopping. Temporarily cover openings to remain.
3. Cut or drill from the exposed or finished side into concealed surfaces to avoid marring existing finished surfaces.
4. Do not use cutting torches until work area is cleared of flammable materials. At concealed spaces, such as duct and pipe interiors, verify condition and contents of hidden space before starting flame-cutting operations. Maintain portable fire-suppression devices during flame-cutting operations.
5. Maintain fire watch during and for at least 8 hours after flame-cutting operations.
6. Maintain adequate ventilation when using cutting torches.
7. Remove decayed, vermin-infested, or otherwise dangerous or unsuitable materials and promptly dispose of off-site.
8. Remove structural framing members and lower to ground by method suitable to avoid free fall and to prevent ground impact or dust generation.
9. Locate selective demolition equipment and remove debris and materials so as not to impose excessive loads on supporting walls, floors, or framing.

D. Site Access and Temporary Controls: Conduct selective demolition and debris-removal operations to ensure minimum interference with roads, streets, walks, walkways, and other adjacent occupied and used facilities.

1. Do not close or obstruct streets, walks, walkways, or other adjacent occupied or used facilities without permission from Owner and authorities having jurisdiction. Provide alternate routes around closed or obstructed trafficways if required by authorities having jurisdiction.
2. Use water mist and other suitable methods to limit spread of dust and dirt. Comply with governing environmental-protection regulations. Do not use water when it may damage adjacent construction or create hazardous or objectionable conditions, such as ice, flooding, and pollution.

3.6 SELECTIVE DEMOLITION PROCEDURES FOR SPECIFIC MATERIALS

A. Concrete:

1. Demolish in sections. Cut concrete full depth at junctures with construction to remain and at regular intervals using power-driven saw, and then remove concrete between saw cuts.

B. Masonry: Demolish in small sections. Cut masonry at junctures with construction to remain, using power-driven saw, and then remove masonry between saw cuts.

C. Concrete Slabs-on-Grade: Saw-cut perimeter of area to be demolished, and then break up and remove.

D. Resilient Floor Coverings: Remove floor coverings and adhesive in accordance with recommendations in RFCI's "Recommended Work Practices for the Removal of Resilient Floor Coverings."

E. Roofing: Remove no more existing roofing than what can be covered in one day by new roofing and so that building interior remains watertight and weathertight. See Division 07 Sections for new roofing requirements.

1. Remove existing roof membrane, flashings, copings, and roof accessories.
2. Remove existing roofing system down to substrate.

3.7 DISPOSAL OF DEMOLISHED MATERIALS

A. Remove demolition waste materials from Project site and recycle or dispose of them in accordance with Section 017419 "Construction Waste Management and Disposal."

1. Do not allow demolished materials to accumulate on-site.

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2. Remove and transport debris in a manner that will prevent spillage on adjacent surfaces and areas.
3. Remove debris from elevated portions of building by chute, hoist, or other device that will convey debris to grade level in a controlled descent.
4. Comply with requirements specified in Section 017419 "Construction Waste Management and Disposal."

B. Burning: Do not burn demolished materials.

3.8 CLEANING

A. Clean adjacent structures and improvements of dust, dirt, and debris caused by selective demolition operations. Return adjacent areas to condition existing before selective demolition operations began.

3.9 SELECTIVE DEMOLITION SCHEDULE

A. Remove: Contractor shall not rely solely on Demolition Drawings to define the full extent of demolition Work. Review all Contract Documents, including structural, mechanical, and electrical drawings, to identify additional demolition required to accommodate new construction. Perform all demolition necessary to complete the Work, whether or not such Work is explicitly indicated. Promptly notify Architect and Owner of any additional demolition requirements or discrepancies prior to proceeding.

B. Remove and Salvage: Contractor shall not rely solely on Demolition Drawings to define the full extent of demolition or salvage Work. Review all Contract Documents, including structural, mechanical, and electrical drawings, to identify additional demolition required to accommodate new construction. Perform all demolition necessary to complete the Work, whether or not such Work is explicitly indicated. Promptly notify Architect and Owner of any additional demolition requirements or discrepancies prior to proceeding.

C. Remove and Reinstall: Contractor shall not rely solely on Demolition Drawings to define the full extent of demolition Work or work to be removed and reinstalled. Review all Contract Documents, including structural, mechanical, and electrical drawings, to identify additional demolition required to accommodate new construction. Perform all demolition necessary to complete the Work, whether or not such Work is explicitly indicated. Promptly notify Architect and Owner of any additional demolition requirements or discrepancies prior to proceeding.

D. Existing to Remain: Contractor shall not rely solely on Demolition Drawings to define the full extent of work to remain. Review all Contract Documents, including structural, mechanical, and electrical drawings, to identify additional demolition required to accommodate new construction. Perform all demolition necessary to complete the Work, whether or not such Work is explicitly indicated. Promptly notify Architect and Owner of any additional demolition requirements or discrepancies prior to proceeding.

END OF SECTION 02 41 19

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SECTION 03 30 00 - CAST-IN-PLACE CONCRETE

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Concrete standards.
2. Concrete materials.
3. Fiber reinforcement.
4. Vapor retarders.
5. Repair materials.
6. Concrete mixture materials.
7. Concrete mixture class types.
8. Concrete mixing.

B. Related Requirements:

1.2 DEFINITIONS

A. Cementitious Materials: Portland cement or blended hydraulic cement alone or in combination with one or more of the following:

1. Fly ash, slag cement, other pozzolans, and silica fume; materials subject to compliance with requirements.

B. Water/Cementitious Materials (w/cm) Ratio: The ratio by weight of mixing water to cementitious materials.

1.3 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1. Require representatives of each entity directly concerned with cast-in-place concrete to attend, including the following:

   a. Contractor's superintendent.
   b. Independent testing agency responsible for inspections and acceptance testing of concrete at Project site.
   c. Ready-mix concrete manufacturer.
   d. Concrete Subcontractor.
   e. Special concrete finish Subcontractor.

2. Review the following:

   a. Special inspection and testing and inspecting agency procedures for field quality control.
   b. Construction joints, control joints, isolation joints, and joint-filler strips.
   c. Semirigid joint fillers.
   d. Vapor-retarder installation.
   e. Anchor rod and anchorage device installation tolerances.
   f. Cold- and hot-weather concreting procedures.
   g. Concrete finishes and finishing.
   h. Curing procedures.
   i. Forms and form-removal limitations.
   j. Shoring and reshoring procedures.
   k. Methods for achieving specified floor and slab flatness and levelness.
   l. Floor and slab flatness and levelness measurements.
   m. Concrete repair procedures.
   n. Concrete protection.
   o. Initial curing of standard-cured and field curing of field-cured test cylinders (ASTM

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C31/C31M.)

p. Protection of field cured field test cylinders.

q. Distribution of test reports.

1.4 ACTION SUBMITTALS

A. Product Data:

1. Portland cement.
2. Blended hydraulic cement.
3. Performance-based hydraulic cement.
4. Fly ash.
5. Slag cement.
6. Silica fume.
7. Aggregates.
8. Admixtures:

    a. Include limitations of use. Admixtures that do not comply with reference ASTM International requirements must be submitted with test data for approval.

9. Color pigments.
10. Fiber reinforcement.
11. Vapor retarders.
12. Curing materials.

    a. Include documentation from color pigment manufacturer, indicating that proposed methods of curing are recommended by color pigment manufacturer.

13. Joint fillers.
14. Repair materials.

B. Design Mixtures: For each concrete mixture, include the following:

1. Mixture identification.
2. Compressive strength at 28 days or other age as specified.
3. Durability exposure classes for Exposure Categories F, S, W, and C.
4. Maximum w/cm ratio.
5. Slump or slump flow limit.
6. Air content.
7. Nominal maximum aggregate size.
8. Synthetic macrofiber content.
9. Intended placement method.
10. Submit adjustments to design mixtures when characteristics of materials, Project conditions, weather, test results, or other circumstances warrant changes.

C. Shop Drawings:

1. Construction Joint Layout: Indicate proposed construction joints required to construct the structure.

    a. Location of construction joints is subject to approval of the Architect.

D. Concrete Schedule: For each location of each class of concrete indicated in "Concrete Mixture Class Types" Article, including the following:

1. Concrete class designation.
2. Location within Project.
3. Exposure class designation.
4. Formed surface finish designation and final finish.
5. Final finish for floors.
6. Floor treatment, if any.

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1.5 INFORMATIONAL SUBMITTALS

A. Qualification Data: For the following:

1. Installer: Include copies of applicable ACI certificates.

B. Material Certificates: For each of the following:

1. Cementitious materials.
2. Admixtures.
3. Fiber reinforcement.
4. Curing compounds.
5. Floor and slab treatments.
6. Bonding agents.
7. Adhesives.
8. Vapor retarders.
9. Semirigid joint filler.
10. Joint-filler strips.
11. Repair materials.

C. Material Test Reports: For the following:

1. Portland cement.
2. Blended hydraulic cement.
3. Performance-based hydraulic cement.
4. Fly ash.
5. Slag cement.
6. Silica fume.
7. Aggregates.
8. Admixtures.

D. Floor surface flatness and levelness measurements report, indicating compliance with specified tolerances in accordance with ACI 117 and in compliance with **ASTM E1155**.

E. Research Reports:

1. For concrete admixtures in accordance with ICC's Acceptance Criteria AC198.
2. For sheet vapor retarder/termite barrier, showing compliance with ICC's Acceptance Criteria AC380.

F. Preconstruction Test Reports: For each mix design.

G. Field quality-control reports.

H. Minutes of preinstallation conference.

1.6 QUALITY ASSURANCE

A. Installer Qualifications: A qualified Installer who employs Project personnel qualified as an ACI-certified Concrete Flatwork Associate and Concrete Flatwork Finisher and a supervisor who is a certified ACI Advanced Concrete Flatwork Finisher/Technician or an ACI Concrete Flatwork Finisher with experience installing and finishing concrete.

1. Post-Installed Concrete Anchors Installers: ACI-certified Adhesive Anchor Installer.

B. Ready-Mixed Concrete Manufacturer Qualifications: A firm experienced in manufacturing ready-mixed concrete products and that complies with ASTM C94/C94M requirements for production facilities and equipment.

1. Manufacturer's production facilities and delivery vehicles certified in accordance with NRMCA's certification requirements or equivalent approval by a State DOT.

C. Laboratory Testing Agency Qualifications: A testing agency qualified in accordance with ASTM C1077 and ASTM E329 for testing that performs duties on behalf of the Architect/Engineer.

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1. Personnel performing laboratory tests to be an ACI-certified Concrete Strength Testing Technician and Concrete Laboratory Testing Technician, Level 1. Testing agency laboratory supervisor tests to be an ACI-certified Concrete Laboratory Testing Technician, Level 2.

D. Field Quality-Control Testing Agency Qualifications: An independent agency, acceptable to authorities having jurisdiction, qualified in accordance with ASTM C1077 and ASTM E329 for testing indicated.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Comply with ASTM C94/C94M and **ACI 301**.

1.8 FIELD CONDITIONS

A. Cold-Weather Placement: Comply with **ACI 301** as follows:

1. Protect concrete work from physical damage or reduced strength that could be caused by frost, freezing actions, or low temperatures.
2. When air temperature has fallen to, or is expected to fall below **40 deg F** during the protection period, maintain delivered concrete mixture temperature within the temperature range required by **ACI 301**.
3. Do not use frozen materials or materials containing ice or snow.
4. Do not place concrete in contact with surfaces less than **35 deg F**, other than reinforcing steel.

B. Hot-Weather Placement: Comply with **ACI 301** and **ACI 305.1**, and as follows:

1. Maintain concrete temperature at time of discharge to not exceed 95 deg F.
2. Fog-spray forms, steel reinforcement, and subgrade just before placing concrete. Keep subgrade uniformly moist without standing water, soft spots, or dry areas.

1.9 WARRANTY

A. Manufacturer's Warranty: Manufacturer agrees to furnish replacement sheet vapor retarder/termite barrier material and accessories for sheet vapor retarder/ termite barrier and accessories that do not comply with requirements or that fail to resist penetration by termites within specified warranty period.

1. Warranty Period: 10 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 CONCRETE STANDARDS

A. ACI Publications: Comply with **ACI 301** unless modified by requirements in the Contract Documents.

2.2 CONCRETE MATERIALS

A. Source Limitations:

1. Obtain all concrete mixtures from a single ready-mixed concrete manufacturer for entire Project.
2. Obtain each type of admixture from single source from single manufacturer.

B. Cementitious Materials:

1. Portland Cement: ASTM C150/C150M, As indicated in the General Structural Notes .
2. Blended Hydraulic Cement: ASTM C595/C595M, As indicated in the General Structural Notes.
3. Performance-Based Hydraulic Cement: ASTM C1157/C1157M: As indicated in the General Structural Notes.
4. Fly Ash: ASTM C 618, As indicated in the General Structural Notes.
5. Slag Cement: ASTM C989/C989M, Grade 100 or 120.

C. Normal-Weight Aggregates:

1. Coarse Aggregate: ASTM C33/C33M, As indicated in the General Structural Notes

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2. Maximum Coarse-Aggregate Size: As indicated in the general structural notes .
3. Fine Aggregate: ASTM C33/C33M Free of materials with deleterious reactivity to alkali in cement.

2.3 ADMIXTURES

A. Air-Entraining Admixture: ASTM C260/C260M.

B. Chemical Admixtures: Do not use calcium chloride or admixtures containing calcium chloride .

1. Water-Reducing Admixture: ASTM C494/C494M, Type A.
2. Retarding Admixture: ASTM C494/C494M, Type B.
3. Water-Reducing and -Retarding Admixture: ASTM C494/C494M, Type D.
4. High-Range, Water-Reducing Admixture: ASTM C494/C494M, Type F.
5. High-Range, Water-Reducing and -Retarding Admixture: ASTM C494/C494M, Type G.

C. Mixing Water for Concrete Mixtures and Water Used to Make Ice: ASTM C1602/C1602M. Include documentation of compliance with limits for alkalis, sulfates, chlorides, or solids content of mixing water from Table 2 in ASTM C1602/C1602M.

2.4 FIBER REINFORCEMENT

A. Synthetic Macrofiber: Synthetic macrofibers complying with ASTM C1116/C1116M, Type III, 1 to 2-1/4 inches long.

2.5 VAPOR RETARDERS

A. Sheet Vapor Retarder, Class A: ASTM E1745, Class A , except with maximum water-vapor permeance of. Include manufacturer's recommended thickness and adhesive or pressure-sensitive tape.

2.6 FLOOR AND SLAB TREATMENTS

A. Emery Dry-Shake Floor Hardener: Unpigmented, factory-packaged, dry combination of portland cement, graded emery aggregate, and plasticizing admixture; with emery aggregate consisting of no less than 60 percent of total aggregate content.

B. Metallic Dry-Shake Floor Hardener: Unpigmented, factory-packaged, dry combination of portland cement, graded metallic aggregate, rust inhibitors, and plasticizing admixture; with metallic aggregate consisting of no less than 65 percent of total aggregate content.

2.7 CURING MATERIALS

A. Absorptive Cover: AASHTO M 182, Class 2, burlap cloth made from jute or kenaf, weighing approximately **9 oz./sq. yd.** when dry.

B. Moisture-Retaining Cover: ASTM C171, polyethylene film burlap-polyethylene sheet.

1. Color:

a. Ambient Temperature Below 50 deg F (10 deg C): Black.
b. Ambient Temperature between 50 and 85 deg F (10 and 29 deg C): Any color.
c. Ambient Temperature Above 85 deg F (29 deg C): White.

C. Water: Potable water that does not cause staining of the surface.

2.8 ACCESSORIES

A. Expansion- and Isolation-Joint-Filler Strips: ASTM D1751, asphalt-saturated cellulosic fiber or ASTM D1752, cork or self-expanding cork.

B. Bonding Agent: ASTM C1059/C1059M, Type II, nonredispersible, acrylic emulsion or styrene

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butadiene.

C. Epoxy Bonding Adhesive: ASTM C881/C881M, two-component epoxy resin, capable of humid curing and bonding to damp surfaces, of class suitable for application temperature and of grade and class to suit requirements, and as follows:

1. Types I and II, nonload bearing Types IV and V, load bearing, for bonding hardened or freshly mixed concrete to hardened concrete.

2.9 CONCRETE MIXTURE MATERIALS

A. Prepare design mixtures for each type and strength of concrete, proportioned on the basis of laboratory trial mixture or field test data, or both, in accordance with **ACI 301**.

1. Use a qualified testing agency for preparing and reporting proposed mixture designs, based on laboratory trial mixtures.

B. Cementitious Materials: Limit percentage, by weight, of cementitious materials other than portland or hydraulic cement in concrete assigned to Exposure Class F3 as follows:

1. Fly Ash: As indicated in the General Structural Notes.
2. Slag Cement: As indicated in the General Structural Notes.

C. Admixtures: Use admixtures in accordance with manufacturer's written instructions.

1. Use corrosion-inhibiting admixture in concrete mixtures where indicated.
2. Use permeability-reducing admixture in concrete mixtures where indicated.

2.10 CONCRETE MIXTURE CLASS TYPES

A. Class A: Normal-weight concrete.

1. Exposure Class: **ACI 318** As indicated in the General Structural Notes .
2. Minimum Compressive Strength: As indicated in the General Structural Notes at 28 days.
3. Maximum w/cm Ratio: As required to meet the requirements of Table 19.3.2.1 of ACI 318.
4. Slump Limit: As indicated in General Structural Notes.
5. Air Content: As required to meet the requirements of Table 19.3.3.1 of ACI 318.

2.11 CONCRETE MIXING

A. Ready-Mixed Concrete: Measure, batch, mix, and deliver concrete in accordance with ASTM C94/C94M and furnish delivery ticket.

B. Project-Site Mixing: Measure, batch, and mix concrete materials and concrete in accordance with ASTM C94/C94M. Mix concrete materials in appropriate drum-type batch machine mixer.

1. For mixer capacity of **1 cu. yd.** or smaller, continue mixing at least 1-1/2 minutes, but not more than five minutes after ingredients are in mixer, before any part of batch is released.
2. For mixer capacity larger than **1 cu. yd.**, increase mixing time by 15 seconds for each additional **1 cu. yd.**.
3. Provide batch ticket for each batch discharged and used in the Work, indicating Project identification name and number, date, mixture type, mixture time, quantity, and amount of water added. Record approximate location of final deposit in structure.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verification of Conditions:

1. Before placing concrete, verify that installation of concrete forms, accessories, reinforcement, and embedded items is complete and that required inspections have been performed.
2. Do not proceed until unsatisfactory conditions have been corrected.

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3.2 PREPARATION

A. Provide reasonable auxiliary services to accommodate field testing and inspections, acceptable to testing agency, including the following:

1. Daily access to the Work.
2. Incidental labor and facilities necessary to facilitate tests and inspections.
3. Secure space for storage, initial curing, and field curing of test samples, including source of water and continuous electrical power at Project site during site curing period for test samples.
4. Security and protection for test samples and for testing and inspection equipment at Project site.

3.3 TOLERANCES

A. Comply with **ACI 117**.

3.4 INSTALLATION OF 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.

1. Use setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
2. Install reglets to receive waterproofing and through-wall flashings in outer face of concrete frame at exterior walls, where flashing is shown at lintels, shelf angles, and other conditions.

3.5 INSTALLATION OF VAPOR RETARDERS

A. Sheet Vapor Retarders: Place, protect, and repair sheet vapor retarder in accordance with ASTM E1643 and manufacturer's written instructions.

1. Install vapor retarder with longest dimension parallel with direction of concrete pour.
2. Face laps away from exposed direction of concrete pour.
3. Lap vapor retarder over footings and grade beams not less than **6 inches**, sealing vapor retarder to concrete.
4. Lap joints **6 inches** and seal with manufacturer's recommended tape.
5. Terminate vapor retarder at the top of floor slabs, grade beams, and pile caps, sealing entire perimeter to floor slabs, grade beams, foundation walls, or pile caps.
6. Seal penetrations in accordance with vapor retarder manufacturer's instructions.
7. Protect vapor retarder during placement of reinforcement and concrete.

    a. Repair damaged areas by patching with vapor retarder material, overlapping damages area by **6 inches** on all sides and sealing to vapor retarder.

B. Bituminous Vapor Retarders: Place, protect, and repair bituminous vapor retarder in accordance with manufacturer's written instructions.

3.6 INSTALLATION OF CAST-IN-PLACE CONCRETE

A. Before placing concrete, verify that installation of formwork, reinforcement, embedded items, and vapor retarder is complete and that required inspections are completed.

1. Immediately prior to concrete placement, inspect vapor retarder for damage and deficient installation, and repair defective areas.
2. Provide continuous inspection of vapor retarder during concrete placement and make necessary repairs to damaged areas as Work progresses.

B. Notify Architect and testing and inspection agencies 24 hours prior to commencement of concrete placement.

C. Water addition in transit or at the Project site must be in accordance with ASTM C94/C94M and must not exceed the permitted amount indicated on the concrete delivery ticket.

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D. Deposit concrete continuously in one layer or in horizontal layers of such thickness that no new concrete is placed on concrete that has hardened enough to cause seams or planes of weakness.

1. If a section cannot be placed continuously, provide construction joints as indicated.
2. Deposit concrete to avoid segregation.
3. Deposit concrete in horizontal layers of depth not to exceed formwork design pressures and in a manner to avoid inclined construction joints.
4. Consolidate placed concrete with mechanical vibrating equipment in accordance with **ACI 301**.

   a. Do not use vibrators to transport concrete inside forms.
   b. Insert and withdraw vibrators vertically at uniformly spaced locations to rapidly penetrate placed layer and at least **6 inches** into preceding layer.
   c. Do not insert vibrators into lower layers of concrete that have begun to lose plasticity.
   d. At each insertion, limit duration of vibration to time necessary to consolidate concrete, and complete embedment of reinforcement and other embedded items without causing mixture constituents to segregate.

E. 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. Do not place concrete floors and slabs in a checkerboard sequence.
2. Consolidate concrete during placement operations, so concrete is thoroughly worked around reinforcement and other embedded items and into corners.
3. Maintain reinforcement in position on chairs during concrete placement.
4. Screed slab surfaces with a straightedge and strike off to correct elevations.
5. Level concrete, cut high areas, and fill low areas.
6. Slope surfaces uniformly to drains where required.
7. Begin initial floating using bull floats or darbies to form a uniform and open-textured surface plane, before excess bleedwater appears on the surface.
8. Do not further disturb slab surfaces before starting finishing operations.

3.7 INSTALLATION OF JOINTS

A. Construct joints true to line, with faces perpendicular to surface plane of concrete.

B. Construction Joints: Coordinate with floor slab pattern and concrete placement sequence.

1. Install so strength and appearance of concrete are not impaired, at locations indicated on Drawings or as approved by Architect.
2. Place joints perpendicular to main reinforcement.

   a. Continue reinforcement across construction joints unless otherwise indicated.

3. Form keyed joints as indicated. Embed keys at least **1-1/2 inches** into concrete.
4. Locate joints for beams, slabs, joists, and girders at third points of spans. Offset joints in girders a minimum distance of twice the beam width from a beam-girder intersection.
5. Locate horizontal joints in walls and columns at underside of floors, slabs, beams, and girders and at the top of footings or floor slabs.
6. Space vertical joints in walls as indicated on Drawings. Unless otherwise indicated on Drawings, locate vertical joints beside piers integral with walls, near corners, and in concealed locations where possible.
7. Use a bonding agent at locations where fresh concrete is placed against hardened or partially hardened concrete surfaces.
8. Use epoxy-bonding adhesive at locations where fresh concrete is placed against hardened or partially hardened concrete surfaces.

C. Control Joints in Slabs-on-Ground: Form weakened-plane control joints, sectioning concrete into areas as indicated. Construct control joints for a depth equal to at least one-fourth of concrete thickness as follows:

1. Grooved Joints: Form control joints after initial floating by grooving and finishing each edge of joint to a radius of **1/8 inch**. Repeat grooving of control joints after applying surface finishes. Eliminate groover tool marks on concrete surfaces.
2. Sawed Joints: Form control joints with power saws equipped with shatterproof abrasive or

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diamond-rimmed blades. Cut **1/8-inch** wide joints into concrete when cutting action does not tear, abrade, or otherwise damage surface and before concrete develops random cracks.

D. Isolation Joints in Slabs-on-Ground: After removing formwork, install joint-filler strips at slab junctions with vertical surfaces, such as column pedestals, 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 on Drawings.
2. Terminate full-width joint-filler strips not less than **1/2 inch** or more than **1 inch** below finished concrete surface, where joint sealants, specified in Section 079200 "Joint Sealants," are indicated.
3. Install joint-filler strips in lengths as long as practicable. Where more than one length is required, lace or clip sections together.

E. Doweled Joints:

1. Install dowel bars and support assemblies at joints where indicated on Drawings.
2. Lubricate or asphalt coat one-half of dowel bar length to prevent concrete bonding to one side of joint.

F. Dowel Plates: Install dowel plates at joints where indicated on Drawings.

3.8 APPLICATION OF FINISHING FLOORS AND SLABS

A. Scratch Finish:

1. While still plastic, texture concrete surface that has been screeded and bull-floated or darbied.
2. Use stiff brushes, brooms, or rakes to produce a profile depth of **1/4 inch** in one direction.
3. Apply scratch finish to surfaces to receive mortar setting beds for bonded cementitious floor finishes.

B. Float Finish:

1. When bleedwater sheen has disappeared and concrete surface has stiffened sufficiently to permit operation of specific float apparatus, consolidate concrete surface with power-driven floats or by hand floating if area is small or inaccessible to power-driven floats.
2. Repeat float passes and restraightening until surface is left with a uniform, smooth, granular texture and complies with **ACI 117** tolerances for conventional concrete.
3. Apply float finish to surfaces to receive trowel finish.

C. Trowel Finish:

1. After applying float finish, apply first troweling and consolidate concrete by hand or power-driven trowel.
2. Continue troweling passes and restraighten until surface is free of trowel marks and uniform in texture and appearance.
3. Grind smooth any surface defects that would telegraph through applied coatings or floor coverings.
4. Do not add water to concrete surface. Use of an approved finishing aid is acceptable.
5. Do not apply troweled finish to concrete, which has a total air content greater than 3 percent.
6. Apply a trowel finish to surfaces exposed to view or to be covered with resilient flooring, carpet, ceramic or quarry tile set over a cleavage membrane, paint, or another thin-film-finish coating system.
7. Finish surfaces to the following tolerances, in accordance with **ASTM E1155**, for a randomly trafficked floor surface:

   a. Slabs on Ground:

      1) Specified overall values of flatness, FF 25; and of levelness, FL 20; with minimum local values of flatness, FF 17; and of levelness, FL 15.

D. Trowel and Fine-Broom Finish: First apply a trowel finish to surfaces indicated on Drawings where ceramic or quarry tile is to be installed by either thickset or thinset method. While concrete is still

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plastic, slightly scarify surface with a fine broom perpendicular to main traffic route.

1. Coordinate required final finish with Architect before application.
2. Comply with flatness and levelness tolerances for trowel-finished floor surfaces.

E. Broom Finish: Apply a broom finish to exterior concrete platforms, steps, ramps, and locations indicated on Drawings.

1. Immediately after float finishing, slightly roughen trafficked surface by brooming with a fiber-bristle broom perpendicular to main traffic route.
2. Coordinate required final finish with Architect before application.

F. Slip-Resistive Finish: Before final floating, apply slip-resistive aggregate finish to concrete stair treads, platforms, and ramps, as indicated on Drawings.

1. Apply in accordance with manufacturer's written instructions and as follows:

a. Uniformly spread 25 lb/100 sq. ft. of dampened slip-resistive aggregate over surface in one or two applications.
b. Tamp aggregate flush with surface, but do not force below surface.
c. After broadcasting and tamping, apply float finish.
d. After curing, lightly work surface with a steel wire brush or an abrasive stone and water to expose slip-resistive aggregate.

G. Dry-Shake Floor Hardener Finish: After initial floating, apply dry-shake floor hardener to surfaces in accordance with manufacturer's written instructions and as follows:

1. Uniformly apply dry-shake floor hardener at a rate of 100 lb/100 sq. ft. unless greater amount is recommended by manufacturer.
2. Uniformly distribute approximately two-thirds of dry-shake floor hardener over surface by hand or with mechanical spreader, and embed by power floating.
3. Follow power floating with a second dry-shake floor hardener application, uniformly distributing remainder of material, and embed by power floating.
4. After final floating, apply a trowel finish.
5. Cure concrete with curing compound recommended by dry-shake floor hardener manufacturer and apply immediately after final finishing.

3.9 APPLICATION OF FINISHING FORMED SURFACES

A. As-Cast Surface Finishes:

1. ACI 301 (ACI 301M) Surface Finish SF-2.0: As-cast concrete texture imparted by form-facing material, arranged in an orderly and symmetrical manner with a minimum of seams.

a. Patch voids larger than **3/4 inch** wide or **1/2 inch** deep.
b. Remove projections larger than **1/4 inch**.
c. Patch tie holes.
d. Surface Tolerance: **ACI 117**, Class B.
e. Locations: Apply to concrete surfaces exposed to public view,.

B. Rubbed Finish: Apply the following to as-cast surface finishes where indicated on Drawings:

1. Smooth-Rubbed Finish:

a. Perform no later than one day after form removal.
b. Moisten concrete surfaces and rub with carborundum brick or another abrasive until producing a uniform color and texture.
c. If sufficient cement paste cannot be drawn from the concrete by the rubbing process, use a grout made from the same cementitious materials used in the in-place concrete.
d. Maintain required patterns or variances as shown on Drawings or to match mockups.

2. Grout-Cleaned Rubbed Finish:

a. Clean concrete surfaces after contiguous surfaces are completed and accessible.
b. Do not clean concrete surfaces as Work progresses.

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c. Mix 1 part portland cement to 1-1/2 parts fine sand, complying with ASTM C144 or ASTM C404, by volume, with sufficient water to produce a mixture with the consistency of thick paint. Add white portland cement in amounts determined by trial patches, so color of dry grout matches adjacent surfaces.
d. Wet concrete surfaces.
e. Scrub grout into voids and remove excess grout. When grout whitens, rub surface with clean burlap, and keep surface damp by fog spray for at least 36 hours.

3.10 INSTALLATION OF MISCELLANEOUS CONCRETE ITEMS

A. Filling in:

1. Fill in holes and openings left in concrete structures after Work of other trades is in place unless otherwise indicated.
2. Mix, place, and cure concrete, as specified, to match color and texture with in-place construction exposed to view.
3. Provide other miscellaneous concrete filling indicated or required to complete the Work.

B. Curbs: Provide monolithic finish to interior curbs by stripping forms while concrete is still green and by troweling surfaces to a hard, dense finish with corners, intersections, and terminations slightly rounded.

C. Equipment Bases and Foundations:

1. Coordinate sizes and locations of concrete bases with actual equipment provided.
2. Construct concrete bases 4 inches high unless otherwise indicated on Drawings, and extend base not less than **6 inches** in each direction beyond the maximum dimensions of supported equipment unless otherwise indicated on Drawings, or unless required for seismic anchor support.
3. Minimum Compressive Strength: 4000 psi at 28 days.
4. Install dowel rods to connect concrete base to concrete floor. Unless otherwise indicated, install dowel rods on **18-inch** centers around the full perimeter of concrete base.
5. For supported equipment, install epoxy-coated anchor bolts that extend through concrete base and anchor into structural concrete substrate.
6. Prior to pouring concrete, place and secure anchorage devices.

   a. Use setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
   b. Cast anchor-bolt insert into bases.
   c. Install anchor bolts to elevations required for proper attachment to supported equipment.

D. Steel Pan Stairs: Provide concrete fill for steel pan stair treads, landings, and associated items.

1. Cast-in inserts and accessories, as shown on Drawings.
2. Screed, tamp, and trowel finish concrete surfaces.

3.11 APPLICATION OF CONCRETE CURING

A. Protect freshly placed concrete from premature drying and excessive cold or hot temperatures.

1. Comply with **ACI 301** for cold weather protection during curing.
2. Comply with **ACI 301** and **ACI 305.1** for hot-weather protection during curing.
3. Maintain moisture loss no more than **0.2 lb/sq. ft. x h**, calculated in accordance with ACI 305R, before and during finishing operations.

B. Curing Formed Surfaces: Comply with **ACI 308.1** as follows:

1. Cure formed concrete surfaces, including underside of beams, supported slabs, and other similar surfaces.
2. Cure concrete containing color pigments in accordance with color pigment manufacturer's instructions.
3. If forms remain during curing period, moist cure after loosening forms.
4. If removing forms before end of curing period, continue curing for remainder of curing period as

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follows:

a. Continuous Fogging: Maintain standing water on concrete surface until final setting of concrete.
b. Continuous Sprinkling: Maintain concrete surface continuously wet.
c. Absorptive Cover: Pre-dampen absorptive material before application; apply additional water to absorptive material to maintain concrete surface continuously wet.
d. Water-Retention Sheeting Materials: Cover exposed concrete surfaces with sheeting material, taping, or lapping seams.
e. Membrane-Forming Curing Compound: Apply uniformly in continuous operation by power spray or roller in accordance with manufacturer's written instructions.

1) Recoat areas subject to heavy rainfall within three hours after initial application.
2) Maintain continuity of coating and repair damage during curing period.

C. Curing Unformed Surfaces: Comply with **ACI 308.1** as follows:

1. Begin curing after finishing concrete.
2. Interior Concrete Floors:

a. Floors to Receive Floor Coverings Specified in Other Sections: Contractor has option of the following:

1) Absorptive Cover: As soon as concrete has sufficient set to permit application without marring concrete surface, install prewetted absorptive cover over entire area of floor.

a) Lap edges and ends of absorptive cover not less than **12 inches**.
b) Maintain absorptive cover water saturated, and in place, for duration of curing period, but not less than seven days.

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.

a) Immediately repair any holes or tears during curing period, using cover material and waterproof tape.
b) Cure for not less than seven days.

3) Ponding or Continuous Sprinkling of Water: Maintain concrete surfaces continuously wet for not less than seven days, utilizing one, or a combination of, the following not in cold weather:

a) Water.
b) Continuous water-fog spray.

b. Floors to Receive Penetrating Liquid Floor Treatments: Contractor has option of the following:

1) Absorptive Cover: As soon as concrete has sufficient set to permit application without marring concrete surface, install prewetted absorptive cover over entire area of floor.

a) Lap edges and ends of absorptive cover not less than **12 inches**.
b) Maintain absorptive cover water saturated, and in place, for duration of curing period, but not less than seven days.

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.

a) Immediately repair any holes or tears during curing period, using cover material and waterproof tape.
b) Cure for not less than seven days.

3) Ponding or Continuous Sprinkling of Water: Maintain concrete surfaces

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continuously wet for not less than seven days, utilizing one, or a combination of, the following:

a) Water.
b) Continuous water-fog spray.

c. Floors to Receive Polished Finish: Contractor has option of the following:

1) Absorptive Cover: As soon as concrete has sufficient set to permit application without marring concrete surface, install prewetted absorptive cover over entire area of floor.

a) Lap edges and ends of absorptive cover not less than **12 inches**.
b) Maintain absorptive cover water saturated, and in place, for duration of curing period, but not less than seven days.

2) Ponding or Continuous Sprinkling of Water: Maintain concrete surfaces continuously wet for not less than seven days, utilizing one, or a combination of, the following:

a) Water.
b) Continuous water-fog spray.

d. Floors To Receive Chemical Stain:

1) As soon as concrete has sufficient set to permit application without marring concrete surface, install curing paper over entire area of floor.
2) Install curing paper square to building lines, without wrinkles, and in a single length without end joints.
3) Butt sides of curing paper tight; do not overlap sides of curing paper.
4) Leave curing paper in place for duration of curing period, but not less than 28 days.

e. Floors To Receive Urethane Flooring:

1) As soon as concrete has sufficient set to permit application without marring concrete surface, install prewetted absorptive cover over entire area of floor.
2) Rewet absorptive cover, and cover immediately with polyethylene moisture-retaining cover with edges lapped **6 inches** and sealed in place.
3) Secure polyethylene moisture-retaining cover in place to prohibit air from circulating under polyethylene moisture-retaining cover.
4) Leave absorptive cover and polyethylene moisture-retaining cover in place for duration of curing period, but not less than 28 days.

f. Floors To Receive Curing Compound:

1) Apply uniformly in continuous operation by power spray or roller in accordance with manufacturer's written instructions.
2) Recoat areas subjected to heavy rainfall within three hours after initial application.
3) Maintain continuity of coating, and repair damage during curing period.
4) Removal: After curing period has elapsed, remove curing compound without damaging concrete surfaces by method recommended by curing compound manufacturer.

g. Floors To Receive Curing and Sealing Compound:

1) Apply uniformly to floors and slabs indicated in a continuous operation by power spray or roller in accordance with manufacturer's written instructions.
2) Recoat areas subjected to heavy rainfall within three hours after initial application.
3) Repeat process 24 hours later, and apply a second coat. Maintain continuity of coating, and repair damage during curing period.

3.12 INSTALLATION OF JOINT FILLING

A. Prepare, clean, and install joint filler in accordance with manufacturer's written instructions.

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1. Defer joint filling until concrete has aged at least one month(s).

B. Remove dirt, debris, saw cuttings, curing compounds, and sealers from joints; leave contact faces of joints clean and dry.

C. Install semirigid joint filler full depth in saw-cut joints and at least **2 inches** deep in formed joints.

D. Overfill joint, and trim joint filler flush with top of joint after hardening.

3.13 INSTALLATION OF CONCRETE SURFACE REPAIRS

A. Defective Concrete:

1. Repair and patch defective areas when approved by Architect.
2. Remove and replace concrete that cannot be repaired and patched to meet specification requirements.

B. Patching Mortar: Mix dry-pack patching mortar, consisting of 1 part portland cement to 2-1/2 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 in excess of **0.01 inch** spalls, air bubbles exceeding surface finish limits, honeycombs, rock pockets, fins and other projections on the surface exceeding surface finish limits, and stains and other discolorations that cannot be removed by cleaning.

1. Immediately after form removal, cut out honeycombs, rock pockets, and voids more than **1/2 inch** in any dimension to solid concrete.

   a. Limit cut depth to **3/4 inch**.
   b. Make edges of cuts perpendicular to concrete surface.
   c. Clean, dampen with water, and brush-coat holes and voids with bonding agent.
   d. Fill and compact with patching mortar before bonding agent has dried.
   e. Fill form-tie voids with patching mortar or cone plugs secured in place with bonding agent.

2. Repair defects on surfaces exposed to view by blending white portland cement and standard portland cement, so that, when dry, patching mortar matches surrounding color.

   a. Patch a test area at inconspicuous locations to verify mixture and color match before proceeding with patching.
   b. Compact mortar in place and match surrounding surface.

3. Repair defects on concealed formed surfaces that will affect concrete's durability and structural performance, as determined by Architect.

D. Repairing Unformed Surfaces:

1. Test unformed surfaces, such as floors and slabs, for finish, and verify surface tolerances specified for each surface.

   a. Correct low and high areas.
   b. Test surfaces sloped to drain for trueness of slope and smoothness; use a sloped template.

2. Repair finished surfaces containing surface defects, including spalls, popouts, 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.
3. After concrete has cured at least 14 days, correct high areas by grinding.
4. Correct localized low areas during, or immediately after, completing surface-finishing operations by adding patching mortar.

   a. Finish repaired areas to blend into adjacent concrete.

5. Correct other low areas scheduled to receive floor coverings with a repair underlayment.

   a. Prepare, mix, and apply repair underlayment and primer in accordance with

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manufacturer's written instructions to produce a smooth, uniform, plane, and level surface.
b. Feather edges to match adjacent floor elevations.

6. Correct other low areas scheduled to remain exposed with repair topping.

a. Cut out low areas to ensure a minimum repair topping depth of **1/4 inch** to match adjacent floor elevations.
b. Prepare, mix, and apply repair topping and primer in accordance with manufacturer's written instructions to produce a smooth, uniform, plane, and level surface.

7. Repair defective areas, except random cracks and single holes **1 inch** or less in diameter, by cutting out and replacing with fresh concrete.

a. Remove defective areas with clean, square cuts, and expose steel reinforcement with at least a **3/4-inch** clearance all around.
b. Dampen concrete surfaces in contact with patching concrete and apply bonding agent.
c. Mix patching concrete of same materials and mixture as original concrete, except without coarse aggregate.
d. Place, compact, and finish to blend with adjacent finished concrete.
e. Cure in same manner as adjacent concrete.

8. Repair random cracks and single holes **1 inch** or less in diameter with patching mortar.

a. Groove top of cracks and cut out holes to sound concrete, and clean off dust, dirt, and loose particles.
b. Dampen cleaned concrete surfaces and apply bonding agent.
c. Place patching mortar before bonding agent has dried.
d. Compact patching mortar and finish to match adjacent concrete.
e. Keep patched area continuously moist for at least 72 hours.

E. Perform structural repairs of concrete, subject to Architect's approval, using epoxy adhesive and patching mortar.

F. Repair materials and installation not specified above may be used, subject to Architect's approval.

3.14 FIELD QUALITY CONTROL

A. Special Inspections: Owner will engage a special inspector to perform field tests and inspections and prepare testing and inspection reports.

B. Testing Agency: Owner will engage a qualified testing and inspecting agency to perform tests and inspections and to submit reports.

1. Testing agency to be responsible for providing curing facility for initial curing of strength test specimens on-site and verifying that test specimens are cured in accordance with standard curing requirements in ASTM C31/C31M.
2. Testing agency to immediately report to Architect, Contractor, and concrete manufacturer any failure of Work to comply with Contract Documents.
3. Testing agency to report results of tests and inspections, in writing, to Owner, Architect, Contractor, and concrete manufacturer within 48 hours of inspections and tests.

a. Test reports to include reporting requirements of ASTM C31/C31M, ASTM C39/C39M, and **ACI 301**, including the following as applicable to each test and inspection:

1) Project name.
2) Name of testing agency.
3) Names and certification numbers of field and laboratory technicians performing inspections and testing.
4) Name of concrete manufacturer.
5) Date and time of inspection, sampling, and field testing.
6) Date and time of concrete placement.
7) Location in Work of concrete represented by samples.
8) Date and time sample was obtained.

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9) Truck and batch ticket numbers.
10) Design compressive strength at 28 days.
11) Concrete mixture designation, proportions, and materials.
12) Field test results of fresh concrete, including slump or slump flow, air content, temperature and density.
13) Information on storage and curing of samples at the Project site, including curing method and maximum and minimum temperatures during initial curing period.
14) Type of fracture and compressive break strengths at seven days and 28 days.

4. Provide a space and source of power or other resources for curing and access to test specimens by the testing agency.

C. Delivery Tickets: comply with ASTM C94/C94M.

D. Inspections:

1. Headed bolts and studs.
2. Verification of use of required design mixture.
3. Concrete placement, including conveying and depositing.
4. Curing procedures and maintenance of curing temperature.
5. Verification of concrete strength before removal of shores and forms from beams and slabs.
6. Batch Plant Inspections: On a random basis, as determined by Architect.

E. Concrete Tests: Testing of composite samples of fresh concrete obtained in accordance with ASTM C 172/C 172M to be performed in accordance with the following requirements:

1. Testing Frequency: Obtain one composite sample for each day's pour of each concrete mixture exceeding **5 cu. yd.**, but less than **25 cu. yd.**, plus one set for each additional 1**50 cu. yd.** or fraction thereof.

   a. When frequency of testing provides fewer than five compressive-strength tests for each concrete mixture, testing is to be conducted from at least five randomly selected batches or from each batch if fewer than five are used.

2. Slump: ASTM C143/C143M:

   a. One test at point of delivery for each composite sample, but not less than one test for each day's pour of each concrete mixture.
   b. Perform additional tests as needed.

3. Air Content: ASTM C231/C231M pressure method, for normal-weight concrete; ASTM C173/C173M volumetric method, for structural lightweight concrete.

   a. One test for each composite sample when strength test specimens are cast, but not less than one test for each day's pour of each concrete mixture.

4. Concrete Temperature: ASTM C1064/C1064M:

   a. One test hourly when air temperature is **40 deg F** and below or **80 deg F** and above, and one test for each composite sample when strength test specimens are cast.

5. Concrete Density: ASTM C138/C138M:

   a. One test for each composite sample when strength test specimens are cast.

6. Unit Weight: ASTM C138/C138M density of fresh structural lightweight concrete.

   a. One test for each composite sample, but not less than one test for each day's pour of each concrete mixture. The fresh density should be consistent with that associated with the equilibrium density within a tolerance of plus or minus 4 lb/ft.3.

7. Compression Test Specimens: ASTM C31/C31M:

   a. Cast and standard cure two sets of two **6 inches** by **12-inches** or **4-inch** by **8-inch** cylindrical specimens for each composite sample.
   b. Cast, and field cure two sets of four standard cylindrical specimens for each composite

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sample.

8. Compressive-Strength Tests: ASTM C39/C39M.

   a. Test one set of two standard cured specimens at seven days and one set of two specimens at 28 days.
   b. Test one set of four field-cured specimens at seven days and one set of two specimens at 28 days.
   c. A compressive-strength test to be the average compressive strength from a set of two specimens obtained from same composite sample and tested at age indicated.

9. When strength of field-cured cylinders is less than 85 percent of companion laboratory-cured cylinders, Contractor to evaluate operations and provide corrective procedures for protecting and curing in-place concrete.
10. Strength of each concrete mixture will be satisfactory if every average of any three consecutive compressive-strength tests of standard cured cylinders equals or exceeds specified compressive strength, and no compressive-strength test value falls below specified compressive strength by more than **500 psi** if specified compressive strength is **5000 psi**, or no compressive strength test value is less than 10 percent of specified compressive strength if specified compressive strength is greater than **5000 psi**.
11. Nondestructive Testing: Impact hammer, sonoscope, or other nondestructive device may be permitted by Architect but will not be used as sole basis for approval or rejection of concrete.
12. Additional Tests:

    a. Testing and inspecting agency to 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.
    b. Testing and inspecting agency may conduct tests to determine adequacy of concrete by cored cylinders complying with ASTM C42/C42M or by other methods as directed by Architect.

       1) Acceptance criteria for concrete strength to be in accordance with **ACI 301**, Section 1.7.6.3.

13. Additional testing and inspecting, at Contractor's expense, will be performed to determine compliance of replaced or additional work with specified requirements.
14. Correct deficiencies in the Work that test reports and inspections indicate do not comply with the Contract Documents.

F. Measure floor and slab flatness and levelness in accordance with **ASTM E1155** within 48 hours of completion of floor finishing and promptly report test results to Architect.

3.15 PROTECTION

A. Protect concrete surfaces as follows:

1. Protect from petroleum stains.
2. Diaper hydraulic equipment used over concrete surfaces.
3. Prohibit vehicles from interior concrete slabs.
4. Prohibit use of pipe-cutting machinery over concrete surfaces.
5. Prohibit placement of steel items on concrete surfaces.
6. Prohibit use of acids or acidic detergents over concrete surfaces.
7. Protect liquid floor treatment from damage and wear during the remainder of construction period. Use protective methods and materials, including temporary covering, recommended in writing by liquid floor treatments installer.
8. Protect concrete surfaces scheduled to receive surface hardener or polished concrete finish using floor slab protective covering.

END OF SECTION 03 30 00

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SECTION 03 54 13 - GYPSUM CEMENT UNDERLAYMENT

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Gypsum cement underlayment.

1.2 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of specified product.

B. Shop Drawings: Include plans indicating substrates, locations, and average depths of underlayment based on survey of substrate conditions.

1.4 INFORMATIONAL SUBMITTALS

A. Test Reports:

1. For fire-resistant ratings, from a qualified testing agency.
2. For STC-rated assemblies, from a qualified testing agency.
3. For IIC-rated assemblies, from a qualified testing agency.

B. Qualification Statements: For Installer.

1.5 QUALITY ASSURANCE

A. Installer Qualifications: Installer who is approved by manufacturer for application of underlayment products required for this Project.

1.6 FIELD CONDITIONS

A. Environmental Limitations: Comply with manufacturer's written instructions for substrate temperature, ventilation, ambient temperature and humidity, and other conditions affecting underlayment performance.

1. Place gypsum cement underlayments only when ambient temperature and temperature of substrates are between **50 and 80 deg F**.

PART 2 - PRODUCTS

2.1 SOURCE LIMITATIONS

A. Obtain gypsum cement underlayment system from a single manufacturer to ensure chemical compatibility and performance requirements.

2.2 PERFORMANCE REQUIREMENTS

A. STC-Rated Assemblies: For STC-rated assemblies, provide materials and construction identical to those tested in assembly indicated, in accordance with ASTM E90 and classified in accordance with ASTM E413 by an independent testing agency.

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1. STC Rating: 55.

B. IIC-Rated Assemblies: For IIC-rated assemblies, provide materials and construction identical to those tested in assembly indicated, in accordance with ASTM E492 and classified in accordance with ASTM E989 by an independent testing agency.

1. IIC Rating: 55.

2.3 GYPSUM CEMENT UNDERLAYMENTS

A. Gypsum Cement Underlayment: Self-leveling, gypsum cement product that can be applied in uniform thickness to match adjacent floor elevations and that can be feathered at edges as recommended in writing by manufacturer.

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. Arcosa Inc.
b. ARDEX Americas
c. Hacker Industries, Inc.
d. MAPEI Corporation
e. Maxxon Corporation
f. Schonox, a Brand of Sika Corporation
g. USG Corporation

2. Cement Binder: Gypsum or blended gypsum cement as defined by ASTM C219.
3. Compressive Strength: Not less than 2500 psi at 28 days when tested in accordance with ASTM C472.
4. Underlayment Additive: Resilient-emulsion product of underlayment manufacturer, formulated for use with underlayment when applied to substrate and conditions indicated.

B. Aggregate: Well-graded, washed gravel, **1/8 to 1/4 inch**; or coarse sand as recommended in writing by underlayment manufacturer.

1. Provide aggregate when recommended in writing by underlayment manufacturer for underlayment thickness required.

C. Water: Potable and at a temperature of not more than **70 deg F**.

D. Primer: Product of underlayment manufacturer recommended in writing for substrate, conditions, and application indicated.

2.4 ACCESSORIES

A. General: Accessory materials recommended in writing by gypsum cement underlayment manufacturer for intended use and compatible with underlayment components.

1. Provide manufacturer's primer, perimeter isolation strips, tapes, sand aggregates, and sealers to suit Project.

B. Patching Materials: Provide products from same manufacturer as underlayment and as recommended in writing by manufacturer.

C. Reinforcement: For underlayment applied to wood substrates, provide galvanized metal lath or other corrosion-resistant reinforcement as recommended in writing by underlayment manufacturer.

D. Corrosion-Resistant Coating: Recommended in writing by underlayment manufacturer for metal substrates.

E. Sound Control Underlayment: Provide sound control mats to comply with STC ratings, IIC ratings, and UL design assembly requirements.

1. Sound Mat Thickness: 1/4" min.

F. Surface Sealer: Provide product recommended in writing by underlayment manufacturer for

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compatibility with specified floor-covering adhesives and to promote surface bonding.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, with Installer present, for conditions affecting performance of the Work.

B. Proceed with application only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Prepare and clean substrate in accordance with manufacturer's written instructions.

B. Crack and Joint Repairs:

1. Treat joints and substrate cracks in accordance with manufacturer's written instructions to prevent cracks from telegraphing (reflecting) through underlayment.
2. Where substrate expansion, isolation, and other moving joints occur, prepare joint of same width to continue through underlayment.
3. Fill substrate voids to prevent underlayment from leaking.

C. Concrete Substrates: Mechanically remove, in accordance with manufacturer's written instructions, laitance, glaze, efflorescence, curing compounds, form-release agents, dust, dirt, grease, oil, and other contaminants that might impair underlayment bond.

1. Moisture Testing: Perform tests so that each test area does not exceed 1000 sq. ft., and perform no fewer than three tests in each installation area and with test areas evenly spaced in installation areas.

a. Relative Humidity Test: Using in-situ probes, ASTM F2170. Proceed with installation only after substrates have a maximum 85 percent relative humidity level measurement, or as recommended in writing by gypsum cement underlayment manufacturer.
b. Anhydrous Calcium Chloride Test, ASTM F1869: Proceed with installation only after substrates do not exceed a maximum moisture-vapor-emission rate of 3 lb of water/1000 sq. ft. in 24 hours.

D. Wood Substrates: Mechanically fasten loose boards and panels to eliminate substrate movement and squeaks. Sand to remove coatings that might impair underlayment bond and remove sanding dust.

1. Install underlayment reinforcement as recommended in writing by manufacturer.

E. Metal Substrates: Mechanically remove, in accordance with manufacturer's written instructions, rust, foreign matter, and other contaminants that might impair underlayment bond. Apply corrosion-resistant coating compatible with underlayment if recommended in writing by underlayment manufacturer.

F. Nonporous Substrates: For ceramic tile, quarry tile, and terrazzo substrates, remove waxes, sealants, and other contaminants that might impair underlayment bond; prepare surfaces in accordance with manufacturer's written instructions.

G. Adhesion Tests: After substrate preparation, test substrate for adhesion with underlayment in accordance with manufacturer's written instructions.

H. Sound Control Underlayment: Install sound control mat materials in accordance with manufacturer's written instructions.

1. Do not install mechanical fasteners that penetrate through the sound control materials.

I. Install and fasten any reinforcement or metal accessories only where specifically recommended in writing by underlayment manufacturer for the substrate and required thickness.

3.3 INSTALLATION OF GYPSUM CEMENT UNDERLAYMENT

A. Install underlayment components in accordance with manufacturer's written instructions.

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1. Close areas to traffic during underlayment installation and for period after installation as recommended in writing by manufacturer.
2. Coordinate installation of components to provide optimum adhesion to substrate and between coats.
3. At substrate expansion, isolation, and other moving joints, allow joint of same width to continue through underlayment.

B. Apply primer over prepared substrate at manufacturer's recommended spreading rate.

C. Mix and install underlayment to produce uniform, level surface in accordance with manufacturer's written instructions.

1. Add aggregate for areas requiring a thickness over **1-1/2 inches**.
2. Install a final layer of underlayment without aggregate to produce a level surface.
3. Feather the edges where required to transition to adjacent surfaces only where the selected product is rated for feathered applications.
4. Protect and maintain required expansion, isolation, and control joints by honoring them through the underlayment.

D. Cure underlayment in accordance with manufacturer's written instructions. Prevent contamination during installation and curing processes.

E. Do not install floor coverings over underlayment until after period recommended in writing by underlayment manufacturer.

F. Apply surface sealer compatible with flooring adhesives at rate recommended in writing by flooring adhesive manufacturer.

G. Remove and replace underlayment areas that evidence lack of bond with substrate, including areas that emit a "hollow" sound when tapped.

3.4 INSTALLATION TOLERANCES

A. Prepare substrates to meet flatness tolerances required by tile and setting material manufacturers and ANSI A108/TCNA standards for the specified tile type and size, including gauged porcelain tile where scheduled. Correct substrates that do not meet these tolerances before tile installation.

3.5 PROTECTION

A. Protect underlayment from concentrated and rolling loads for remainder of construction period.

END OF SECTION 03 54 13

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SECTION 04 22 00 - CONCRETE UNIT MASONRY

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Concrete masonry units.
2. Lintels.
3. Mortar and grout materials.
4. Reinforcement.
5. Ties and anchors.
6. Embedded flashing.
7. Mortar and grout mixes.

B. Products Installed, but Not Furnished, under This Section:

1. Precast architectural concrete trim in concrete unit masonry.
2. Brick veneer in concrete unit masonry.
3. Cast-stone trim in concrete unit masonry.
4. Steel lintels in concrete unit masonry.
5. Steel shelf angles for supporting concrete unit masonry.

C. Related Requirements:

1. Section 033000 "Cast-in-Place Concrete" for dovetail slots for masonry anchors.
2. Section 034500 "Precast Architectural Concrete" for precast concrete trim.
3. Section 051200 "Structural Steel Framing" for installing anchor sections of adjustable masonry anchors for connecting to structural steel frame.
4. Section 055000 "Metal Fabrications" for furnishing steel lintels and shelf angles.
5. Section 076200 "Sheet Metal Flashing and Trim" for exposed sheet metal flashing and for furnishing manufactured reglets installed in masonry joints.

1.2 DEFINITIONS

A. CMU(s): Concrete masonry unit(s).

B. Reinforced Masonry: Masonry containing reinforcing steel in grouted cells.

C. Exposed: Weather-exposed side of a constructed wall.

1.3 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of specified product.

B. Shop Drawings:

1. Masonry Units: Show sizes, profiles, coursing, and locations of special shapes.
2. Reinforcing Steel: Detail bending, lap lengths, and placement of unit masonry reinforcing bars. Comply with ACI PRC 315R. Indicate elevations of reinforced walls.
3. Lintel design and types required.

C. Samples for Initial Selection:

1. Architectural CMUs: Small-scale units.
2. Colored Mortar: Full range of manufacturer's standard colors.

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3. Aggregate for Mortar: Range of aggregate colors for colored-aggregate mortar.

D. Samples for Verification: For each type and color of the following:

1. Architectural CMUs: Full-size units, minimum of five.
2. Colored mortar.
3. Pigmented Mortar: Make Samples using same sand and mortar ingredients to be used on Project.
4. Colored-Aggregate Mortar: Make Samples using same sand and mortar ingredients to be used on Project.

1.5 INFORMATIONAL SUBMITTALS

A. Material Certificates: For each type and size of the following:

1. Masonry units.

   a. Include data on material properties.
   b. For masonry units used in structural masonry, include data and calculations establishing average net-area compressive strength of units.

2. Integral water repellent used in CMUs, if not surface treated.
3. Cementitious materials. Include name of manufacturer, brand name, and type.
4. Mortar admixtures.
5. Preblended, dry mortar mixes. Include description of type and proportions of ingredients.
6. Grout mixes. Include description of type and proportions of ingredients.
7. Reinforcing bars.
8. Joint reinforcement.
9. Anchors, ties, and metal accessories.

B. Mix Designs: For each type of mortar and grout. Include description of type and proportions of ingredients.

1. Include test reports for mortar mixes required to comply with property specification. Test in accordance with ASTM C109/C109M for compressive strength, ASTM C1506 for water retention, and ASTM C91/C91M for air content.
2. Include test reports, in accordance with ASTM C1019, for grout mixes required to comply with compressive strength requirement.

C. Qualification Statements: For testing agency.

D. Statement of Compressive Strength of Masonry: For each combination of masonry unit type and mortar type, provide statement of average net-area compressive strength of masonry units, mortar type, and resulting net-area compressive strength of masonry determined in accordance with TMS 402/602.

E. Weather Procedures: Detailed description of methods, materials, and equipment to be used to comply with requirements for cold and hot weather.

1.6 QUALITY ASSURANCE

A. Installer Qualifications: All masonry flashing installers must complete the International Masonry Institute Flashing Upgrade training course.

B. Testing Agency: Qualified in accordance with ASTM C1093 for testing indicated.

1.7 MOCKUPS

A. Wall Mockups: Build mockups to verify selections made under Sample submittals and to set quality standards for installation.

1. Build mockups for each type of exposed unit masonry construction in sizes approximately 48 inches long by 48 inches high by full thickness, including face and backup wythes and accessories.

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a. Include a sealant-filled joint at least **16 inches** long in each mockup.
b. Include lower corner of window opening at upper corner of exterior wall mockup. Make opening approximately **12 inches** wide by **16 inches** high.
c. Include through-wall flashing installed for a **24-inch** length in corner of exterior wall mockup approximately **16 inches** down from top of mockup, with a **12-inch** length of flashing left exposed to view (omit masonry above half of flashing).

2. Where masonry is to match existing, erect mockups adjacent and parallel to existing surface.
3. Clean exposed faces of mockups with masonry cleaner as indicated.
4. Protect accepted mockups from the elements with weather-resistant membrane.
5. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Owner specifically approves such deviations by Change Order.
6. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.8 DELIVERY, STORAGE, AND HANDLING

A. Store masonry units on elevated platforms in a dry location. If units are not stored in an enclosed location, cover tops and sides of stacks with waterproof sheeting, securely tied. If units become wet, do not install until they are dry.

B. Store cementitious materials on elevated platforms, under cover, and in a dry location. Do not use cementitious materials that have become damp.

C. Store aggregates where grading and other required characteristics can be maintained and contamination avoided.

D. Deliver preblended, dry mortar mix in moisture-resistant containers. Store preblended, dry mortar mix in delivery containers on elevated platforms in a dry location or in covered weatherproof dispensing silos.

E. Store masonry accessories, including metal items, to prevent corrosion and accumulation of dirt and oil.

1.9 FIELD CONDITIONS

A. Protection of Masonry: During construction, cover tops of walls, projections, and sills with waterproof sheeting at end of each day's work. Cover partially completed masonry when construction is not in progress.

1. Extend cover a minimum of **24 inches** down both sides of walls, and hold cover securely in place.

B. Do not apply uniform floor or roof loads for at least 12 hours and concentrated loads for at least three days after building masonry walls or columns.

C. Stain Prevention: Prevent grout, mortar, and soil from staining the face of masonry to be left exposed or painted. Immediately remove grout, mortar, and soil that come in contact with such masonry.

1. Protect base of walls from rain-splashed mud and from mortar splatter by spreading coverings on ground and over wall surface.
2. Protect sills, ledges, and projections from mortar droppings.
3. Protect surfaces of window and door frames, as well as similar products with painted and integral finishes, from mortar droppings.
4. Turn scaffold boards near the wall on edge at the end of each day to prevent rain from splashing mortar and dirt onto completed masonry.

D. Cold-Weather Requirements: Do not use frozen materials or materials mixed or coated with ice or frost. Do not build on frozen substrates. Remove and replace unit masonry damaged by frost or by freezing conditions. Comply with cold-weather construction requirements contained in TMS 402/602.

1. Cold-Weather Cleaning: Use liquid cleaning methods only when air temperature is **40 deg F** and higher and will remain so until masonry has dried, but not less than seven days after completing cleaning.

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E. Hot-Weather Requirements: Comply with hot-weather construction requirements contained in TMS 402/602.

PART 2 - PRODUCTS

2.1 SOURCE LIMITATIONS

A. Obtain exposed masonry units from single producer or manufacturer.

B. For exposed masonry units, obtain each color and grade from single source with resources to provide materials of consistent quality in appearance and physical properties.

2.2 PERFORMANCE REQUIREMENTS

A. Provide structural unit masonry that develops indicated net-area compressive strengths at 28 days.

1. Determine net-area compressive strength of masonry from average net-area compressive strengths of masonry units and mortar types (unit-strength method) in accordance with TMS 402/602.

2.3 CONCRETE UNIT MASONRY, GENERAL

A. Masonry Standard: Comply with TMS 402/602 except as modified by requirements in the Contract Documents.

B. Defective Units: Referenced masonry unit standards may allow a certain percentage of units to contain chips, cracks, or other defects exceeding limits stated. Do not use units where such defects are exposed in the completed Work .

C. Fire-Resistance Ratings: Comply with requirements for fire-resistance-rated assembly designs indicated.

1. Where fire-resistance-rated construction is indicated, use the equivalent thickness method for masonry units in accordance with Tech Note TEK 07-01D.

2.4 CONCRETE MASONRY UNITS

A. General: Provide shapes indicated and as follows, with exposed surfaces matching exposed faces of adjacent units unless otherwise indicated.

1. Provide special shapes for lintels, corners, jambs, sashes, movement joints, headers, bonding, and other special conditions.
2. Provide square-edged units for outside corners unless otherwise indicated.

B. CMUs : ASTM C90, normal weight unless otherwise indicated.

1. Size (Width): Manufactured to dimensions **3/8 inch** less-than-nominal dimensions.
2. Exposed Faces: Provide color and texture matching the range represented by Architect's sample.

C. Architectural CMUs: ASTM C90, normal-weight architectural units.

1. Size (Width): Manufactured to dimensions **3/8 inch** less-than-nominal dimensions.
2. Pattern and Texture: Standard pattern, ground-face finish Standard pattern, split-face finish. Match Architect's samples.
3. Colors: As indicated by manufacturer's designations or Match Architect's samples or As selected by Architect from manufacturer's full range.
4. Special Aggregate: Provide units made with aggregate matching aggregate in Architect's sample.

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2.5 LINTELS

A. Masonry Lintels : Prefabricated or built-in-place masonry lintels made from bond beam CMUs matching adjacent CMUs in color, texture, and density classification, with reinforcing bars placed as indicated and filled with coarse grout. Cure precast lintels before handling and installing. Temporarily support built-in-place lintels until cured.

2.6 MORTAR AND GROUT MATERIALS

A. General: Provide mortar and grout materials to achieve performance requirements as specified in mortar and grout mixes.

B. Portland Cement : ASTM C150/C150M, Type I or II, except Type III may be used for cold-weather construction. Provide natural color or white cement as required to produce mortar color indicated.

1. Alkali content is not more than 0.1 percent when tested in accordance with ASTM C114.

C. Hydrated Lime : ASTM C207, Type S.

D. Portland Cement-Lime Mix : Packaged blend of portland cement and hydrated lime containing no other ingredients.

E. Masonry Cement: ASTM C91/C91M.

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. Argos USA LLC
b. Cemex S.A.B. de C.V.
c. Fairborn Cement Company
d. Federal White Cement, Ltd.
e. Heidelberg Materials
f. Lafarge North America Inc.
g. LafargeHolcim
h. Lehigh White Cement Company
i. Quikrete; The QUIKRETE Companies, LLC
j. Sakrete; CRH Americas, Oldcastle APG

F. Mortar Cement: ASTM C1329/C1329M.

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. Lafarge North America Inc.

G. Mortar Pigments: Natural and synthetic iron oxides and chromium oxides, compounded for use in mortar mixes and complying with ASTM C979/C979M. Use only pigments with a record of satisfactory performance in masonry mortar.

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. Davis Colors
b. Euclid Chemical Company (The); a subsidiary of RPM International, Inc.
c. Lanxess Corporation
d. Solomon Colors Inc.

H. Colored Mortar: Packaged blend made from portland cement-lime mix lime or masonry cement and mortar pigments, all complying with specified requirements, and containing no other ingredients.

1. Colored Portland Cement-Lime Mix:

a. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

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1) Argos USA LLC
2) Heidelberg Materials
3) Lafarge North America Inc.
4) LafargeHolcim

2. Colored Masonry Cement:

a. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1) Argos USA LLC
2) Cemex S.A.B. de C.V.
3) Fairborn Cement Company
4) Heidelberg Materials
5) Lafarge North America Inc.
6) LafargeHolcim

3. Formulate blend as required to produce color indicated or, if not indicated, as selected from manufacturer's standard colors.
4. Pigments does not exceed 10 percent of portland cement by weight.

I. Aggregate for Mortar : ASTM C144.

1. For mortar that is exposed to view, use washed aggregate consisting of natural sand or crushed stone.
2. For joints less than **1/4 inch** thick, use aggregate graded with 100 percent passing the **No. 16** sieve.
3. White-Mortar Aggregates: Natural white sand or crushed white stone.
4. Colored-Mortar Aggregates: Natural sand or crushed stone of color necessary to produce required mortar color.

J. Aggregate for Grout : ASTM C404.

K. Cold-Weather Admixture: Nonchloride, noncorrosive, accelerating admixture complying with ASTM C494/C494M, Type C, and recommended by manufacturer for use in masonry mortar of composition indicated.

1. 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. Euclid Chemical Company (The); a subsidiary of RPM International, Inc.
b. GCP Applied Technologies Inc.

L. Water-Repellent Mortar Admixture: Liquid water-repellent admixture added to mortar, intended for use with CMUs containing integral water repellent from same manufacturer.

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. ACM Chemistries
b. Euclid Chemical Company (The); a subsidiary of RPM International, Inc.
c. GCP Applied Technologies Inc.
d. Master Builders Solutions

M. Water: Potable.

2.7 REINFORCEMENT

A. Uncoated-Steel Reinforcing Bars : ASTM A615/A615M or ASTM A996/A996M, **Grade 60**.

B. Masonry-Joint Reinforcement : Ladder type complying with ASTM A951/A951M.

1. Interior Walls: Hot-dip galvanized carbon steel.
2. Exterior Walls: Hot-dip galvanized carbon steel.

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3. Wire Size for Side Rods: 0.148-inch min. diameter.
4. Wire Size for Cross Rods: 0.148-inch min. diameter.
5. Spacing of Cross Rods: Not more than **16 inches** o.c.
6. Provide in lengths of not less than **10 ft.**.

2.8 TIES AND ANCHORS

A. General: Ties and anchors extend at least **1-1/2 inches** into masonry but with at least a **5/8-inch** cover on outside face.

B. Materials: Provide ties and anchors specified in this article that are made from materials that comply with the following unless otherwise indicated:

1. Mill-Galvanized, Carbon-Steel Wire: ASTM A1064/A1064M, with ASTM A641/A641M, Class 1 coating.
2. Hot-Dip Galvanized, Carbon-Steel Wire: ASTM A1064/A1064M, with ASTM A153/A153M, Class B coating.
3. Stainless Steel Wire: ASTM A580/A580M, Type 316.
4. Mill Galvanized-Steel Sheet: ASTM A653/A653M, Commercial Steel, **G60** zinc coating.
5. Steel Sheet, Galvanized after Fabrication: ASTM A1008/A1008M commercial steel, with ASTM A153/A153M, Class B coating.
6. Stainless Steel Sheet: ASTM A240/A240M or ASTM A666, Type 316.
7. Steel Plates, Shapes, and Bars: ASTM A36/A36M.

C. Adjustable Anchors for Connecting to Structural Steel Framing : Provide anchors that allow vertical or horizontal adjustment but resist tension and compression forces perpendicular to plane of wall.

1. Anchor Section for Welding to Steel Frame: Crimped **1/4-inch-** diameter, hot-dip galvanized steel wire.
2. Tie Section: Triangular-shaped wire tie made from 0.25-inch- diameter, hot-dip galvanized steel wire.

2.9 EMBEDDED FLASHING

A. Embedded Flashing Applications: Unless otherwise indicated, use the following:

1. Where flashing is indicated to receive counterflashing, use metal flashing.
2. Where flashing is indicated to be turned down at or beyond the wall face, use metal flashing.
3. Where flashing is partly exposed and is indicated to terminate at the wall face, use metal flashing with a drip edge.
4. Where flashing is fully concealed, use metal flashing or flexible flashing.

B. Metal Flashing: Provide metal flashing complying with SMACNA's "Architectural Sheet Metal Manual."

1. Stainless Steel: ASTM A240/A240M or ASTM A666, Type 316, **0.016 inch** thick.
2. Copper: ASTM B370, Temper H00, cold-rolled copper sheet, 16 oz./sq. ft. weight or 0.0216 inch thick or ASTM B370, Temper H01, high-yield copper sheet, 12 oz./sq. ft. weight or 0.0162 inch thick.
3. Fabricate continuous flashings in sections **96 inches** long minimum, but not exceeding **12 ft.**. Provide splice plates at joints of formed, smooth metal flashing.
4. Fabricate through-wall metal flashing embedded in masonry from stainless steel, with ribs at **3-inch** intervals along length of flashing to provide an integral mortar bond.
5. Fabricate through-wall flashing with snaplock receiver on exterior face where indicated to receive counterflashing.
6. Fabricate through-wall flashing with drip edge unless otherwise indicated. Fabricate by extending flashing **1/2 inch** out from wall, with outer edge bent down 30 degrees and hemmed.
7. Fabricate through-wall flashing with sealant stop unless otherwise indicated. Fabricate by bending metal back on itself **3/4 inch** at exterior face of wall and down into joint **1/4 inch** to form a stop for retaining sealant backer rod.
8. Fabricate metal drip edges for ribbed metal flashing from plain metal flashing of same metal as ribbed flashing and extending at least **3 inches** into wall with hemmed inner edge to receive ribbed flashing and form a hooked seam. Form hem on upper surface of metal so that completed seam sheds water.

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C. Flexible Flashing: Where flashing is fully concealed in masonry, use one of the following unless otherwise indicated:

1. Asphalt-Coated Copper Flashing: Copper sheet coated with flexible asphalt.

   a. Sheet Weight: 5 oz./sq. ft..

2. Self-Adhering, Stainless Steel Fabric Flashing: Composite, flashing product consisting of minimum **2-mil-** thick stainless steel sheet, bonded to a layer of polymeric fabric.

   a. Grade: Type 316.
   b. Bonding Agent: Permanent, clear adhesive.
   c. Overall Thickness: Manufacturer's standard.

3. Rubberized-Asphalt Flashing: Composite flashing product consisting of a pliable, adhesive rubberized-asphalt compound, bonded to a high-density, cross-laminated polyethylene film.

   a. Overall Thickness: Not less than 30 mils.

4. Butyl Rubber Flashing: Composite, self-adhesive, flashing product consisting of a pliable, butyl rubber compound, bonded to a high-density polyethylene film, aluminum foil, or spunbonded polyolefin.

   a. Overall Thickness: Not less than 35 mils.

D. Preformed Corners, End Dams, and Seaming Shapes for Flashing: Flashing manufacturer's standard products or products recommended by flashing manufacturer for waterproofing openings.

E. Adhesives, Primers, and Seam Tapes for Flashings: Flashing manufacturer's standard products or products recommended by flashing manufacturer for bonding flashing sheets to each other and to substrates.

2.10 ACCESSORIES

A. Compressible Filler: Premolded filler strips complying with ASTM D1056, Grade 2A1; compressible up to 35 percent; of width and thickness indicated; formulated from neoprene.

B. Preformed Control-Joint Gaskets: Made from styrene-butadiene-rubber compound, complying with ASTM D2000, Designation M2AA-805 or PVC, complying with ASTM D2287, Type PVC-65406 and designed to fit standard sash block and to maintain lateral stability in masonry wall; size and configuration as indicated.

C. Bond-Breaker Strips: Asphalt-saturated felt complying with ASTM D226/D226M, Type I (No. 15 asphalt felt).

D. Masonry-Cell Fill: Loose-fill insulation, perlite complying with ASTM C549, Type II (surface treated for water repellency and limited moisture absorption) or Type IV (surface treated for water repellency and to limit dust generation).

2.11 MORTAR AND GROUT MIXES

A. General: Do not use admixtures, including pigments, air-entraining agents, accelerators, retarders, water-repellent agents, antifreeze compounds, or other admixtures unless otherwise indicated.

   1. Do not use calcium chloride in mortar or grout.
   2. Use portland cement-lime mortar unless otherwise indicated.
   3. Add cold-weather admixture (if used) at same rate for all mortar that will be exposed to view, regardless of weather conditions, to ensure that mortar color is consistent.

B. Preblended, Dry Mortar Mix: Furnish dry mortar ingredients in form of a preblended mix. Measure quantities by weight to ensure accurate proportions, and thoroughly blend ingredients before delivering to Project site.

C. Mortar for Unit Masonry: Comply with ASTM C270, Property Specification. Provide the following types of mortar for applications stated unless another type is indicated or needed to provide required

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compressive strength of masonry.

1. For masonry below grade or in contact with earth, use Type M.
2. For reinforced masonry, use Type S.
3. For mortar parge coats, use Type S.
4. For exterior, above-grade, load-bearing and non-load-bearing walls and parapet walls; for interior load-bearing walls; for interior non-load-bearing partitions; and for other applications where another type is not indicated, use Type N.
5. For interior non-load-bearing partitions, Type O may be used instead of Type N.

D. Pigmented Mortar: Use colored cement product or select and proportion pigments with other ingredients to produce color required. Do not add pigments to colored cement products.

1. Pigments does not exceed 5 percent of masonry cement or mortar cement by weight.
2. Mix to match Architect's sample.

E. Colored-Aggregate Mortar: Produce required mortar color by using colored aggregates and natural color or white cement as necessary to produce required mortar color.

1. Mix to match Architect's sample.

F. Grout for Unit Masonry: Comply with ASTM C476.

1. Use grout of type indicated or, if not otherwise indicated, of type (fine or coarse) that will comply with TMS 402/602 for dimensions of grout spaces and pour height.
2. Proportion grout in accordance with ASTM C476, Table 1 or paragraph 4.2.2 for specified 28-day compressive strength indicated, but not less than 2000 psi.
3. Provide grout with a slump of 8 to 11 inches as measured in accordance with ASTM C143/C143M.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.

1. For the record, prepare written report, endorsed by Installer, listing conditions detrimental to performance of the Work.
2. Verify that foundations are within tolerances specified.
3. Verify that reinforcing dowels are properly placed.
4. Verify that substrates are free of substances that would impair mortar bond.

B. Before installation, examine rough-in and built-in construction for piping systems to verify actual locations of piping.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION, GENERAL

A. Build chases and recesses to accommodate items specified in this and other Sections.

B. Leave openings for equipment to be installed before completing masonry. After installing equipment, complete masonry to match construction immediately adjacent to opening.

C. Use full-size units without cutting if possible. If cutting is required to provide a continuous pattern or to fit adjoining construction, cut units with motor-driven saws; provide clean, sharp, unchipped edges. Allow units to dry before laying unless wetting of units is specified. Install cut units with cut surfaces and, where possible, cut edges concealed.

D. Exposed Masonry: Mix units to produce uniform blend of colors and textures.

E. Matching Existing Masonry: Match coursing, bonding, color, and texture of existing masonry.

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F. Temperature Control: Perform temperature-sensitive construction procedures while masonry Work is progressing. Temperature ranges indicated below apply to air temperatures existing at time of installation except for grout. For grout, temperature ranges apply to anticipated minimum night temperatures. In heating mortar and grout materials, maintain mixing temperature selected within **10 deg F**.

1. 40 to 32 Deg F (4 to 0 Deg C):

   a. Mortar: Heat mixing water to produce mortar temperature between **40 and 120 deg F**.
   b. Grout: Follow normal masonry procedures.

2. 32 to 25 Deg F (0 to Minus 4 Deg C):

   a. Mortar: Heat mixing water and sand to produce mortar temperatures between **40 and 120 deg F**; maintain temperature of mortar on boards above freezing.
   b. Grout: Heat grout materials to **90 deg F** to produce in-place grout temperature of **70 deg F** at end of workday.

3. 25 to 20 Deg F (Minus 4 to 7 Deg C):

   a. Mortar: Heat mixing water and sand to produce mortar temperatures between **40 and 120 deg F**; maintain temperature of mortar on boards above freezing.
   b. Grout: Heat grout materials to **90 deg F** to produce in-place grout temperature of **70 deg F** at end of workday.
   c. Heat both sides of walls under construction using salamanders or other heat sources.
   d. Use windbreaks or enclosures when wind is in excess of 15 mph.

4. 20 Deg F (Minus 7 Deg C) and Below:

   a. Mortar: Heat mixing water and sand to produce mortar temperatures between **40 and 120 deg F**.
   b. Grout: Heat grout materials to **90 deg F** to produce in-place grout temperature of **70 deg F** at end of workday.
   c. Masonry Units: Heat masonry units so that they are above **20 deg F** at time of laying.
   d. Provide enclosure and auxiliary heat to maintain an air temperature of at least **40 deg F** for 24 hours after laying units.

5. Do not heat water for mortar and grout to above **160 deg F**.

G. Masonry Protection: Protect completed masonry and masonry not being worked on in the following manner. Temperature ranges indicated apply to mean daily air temperatures except for grouted masonry. For grouted masonry, temperature ranges apply to anticipated minimum night temperatures.

1. 40 to 32 Deg F (4 to 0 Deg C): Protect masonry from rain or snow for at least 24 hours by covering with weather-resistive membrane.
2. 32 to 25 Deg F (0 to Minus 4 Deg C): Completely cover masonry with weather-resistive membrane for at least 24 hours.
3. 25 to 20 Deg F (Minus 4 to 7 Deg C): Completely cover masonry with weather-resistive insulating blankets or similar protection for at least 24 hours, 48 hours for grouted masonry.
4. 20 Deg F (Minus 7 Deg C) and Below: Except as otherwise indicated, maintain masonry temperature above 32 deg F (0 deg C) for 24 hours using enclosures and supplementary heat, electric heating blankets, infrared lamps or other methods proven to be satisfactory. For grouted masonry, maintain heated enclosure to **40 deg F** for 48 hours.

3.3 TOLERANCES

A. Dimensions and Locations of Elements:

1. For dimensions in cross section or elevation, do not vary by more than plus **1/2 inch** or minus **1/4 inch**.
2. For location of elements in plan, do not vary from that indicated by more than plus or minus **1/2 inch**.
3. For location of elements in elevation, do not vary from that indicated by more than plus or minus **1/4 inch** in a story height or **1/2 inch** total.

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B. Lines and Levels:

1. For bed joints and top surfaces of bearing walls, do not vary from level by more than **1/4 inch in 10 ft.**, or **1/2 inch** maximum.
2. For conspicuous horizontal lines, such as lintels, sills, parapets, and reveals, do not vary from level by more than **1/8 inch in 10 ft.**, **1/4 inch in 20 ft.**, or **1/2 inch** maximum.
3. For vertical lines and surfaces, do not vary from plumb by more than **1/4 inch in 10 ft.**, **3/8 inch in 20 ft.**, or **1/2 inch** maximum.
4. For conspicuous vertical lines, such as external corners, door jambs, reveals, and expansion and control joints, do not vary from plumb by more than **1/8 inch in 10 ft.**, **1/4 inch in 20 ft.**, or **1/2 inch** maximum.
5. For lines and surfaces, do not vary from straight by more than **1/4 inch in 10 ft.**, **3/8 inch in 20 ft.**, or **1/2 inch** maximum.
6. For vertical alignment of exposed head joints, do not vary from plumb by more than **1/4 inch in 10 ft.** or **1/2 inch** maximum.
7. For faces of adjacent exposed masonry units, do not vary from flush alignment by more than **1/16 inch**.

C. Joints:

1. For bed joints, do not vary from thickness indicated by more than plus or minus **1/8 inch**, with a maximum thickness limited to **1/2 inch**.
2. For exposed bed joints, do not vary from bed-joint thickness of adjacent courses by more than **1/8 inch**.
3. For head and collar joints, do not vary from thickness indicated by more than plus **3/8 inch** or minus **1/4 inch**.
4. For exposed head joints, do not vary from thickness indicated by more than plus or minus **1/8 inch**.

3.4 INSTALLATION OF MASONRY WALLS

A. Lay out walls in advance for accurate spacing of surface bond patterns with uniform joint thicknesses and for accurate location of openings, movement-type joints, returns, and offsets. Avoid using less-than-half-size units, particularly at corners, jambs, and, where possible, at other locations.

B. Bond Pattern for Exposed Masonry: Unless otherwise indicated, lay exposed masonry in running bond; do not use units with less-than-nominal **4-inch** horizontal face dimensions at corners or jambs.

C. Lay concealed masonry with all units in a wythe in running bond or bonded by lapping not less than 4 inches. Bond and interlock each course of each wythe at corners. Do not use units with less-than-nominal **4-inch** horizontal face dimensions at corners or jambs.

D. Stopping and Resuming Work: Stop work by stepping back units in each course from those in course below; do not tooth. When resuming work, clean masonry surfaces that are to receive mortar, remove loose masonry units and mortar, and wet brick if required before laying fresh masonry.

E. Built-in Work: As construction progresses, build in items specified in this and other Sections. Fill in solidly with masonry around built-in items.

F. Fill space between steel frames and masonry solidly with mortar unless otherwise indicated.

G. Where built-in items are to be embedded in cores of hollow masonry units, place a layer of metal lath, wire mesh, or plastic mesh in the joint below, and rod mortar or grout into core.

H. Fill cores in hollow CMUs with grout **24 inches** under bearing plates, beams, lintels, posts, and similar items unless otherwise indicated.

I. Rigid, Cellular Thermal Insulation, CMUs: Install molded-polystyrene insulation units into masonry unit cells before laying units.

J. Build non-load-bearing interior partitions full height of story to underside of solid floor or roof structure above unless otherwise indicated.

1. Install compressible filler in joint between top of partition and underside of structure above.

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2. Fasten partition top anchors to structure above and build into top of partition. Grout cells of hollow CMUs solidly around plastic tubes of anchors and push tubes down into grout to provide **1/2-inch** clearance between end of anchor rod and end of tube. Space anchors 48 inches o.c. unless otherwise indicated.
3. Wedge non-load-bearing partitions against structure above with small pieces of tile, slate, or metal. Fill joint with mortar after dead-load deflection of structure above approaches final position.
4. At fire-rated partitions, treat joint between top of partition and underside of structure above to comply with Section 078443 "Joint Firestopping."
5. Joint Sealants: Comply with ASTM C1193 for use of joint sealants, including acoustic sealants as applicable to materials, applications and Project conditions.
6. Penetration Firestopping: Install penetration firestopping systems for Project applications to comply with manufacturer's written installation instructions.

3.5 INSTALLATION OF MORTAR BEDDING AND JOINTING

A. Lay hollow CMUs as follows:

1. Bed face shells in mortar and make head joints of depth equal to bed joints.
2. Bed webs in mortar in all courses of piers, columns, and pilasters.
3. Bed webs in mortar in grouted masonry, including starting course on footings.
4. Fully bed entire units, including areas under cells, at starting course on footings where cells are not grouted.

B. Lay solid CMUs with completely filled bed and head joints; butter ends with sufficient mortar to fill head joints and shove into place. Do not deeply furrow bed joints or slush head joints.

C. Where applicable, set masonry trim units in full bed of mortar with full vertical joints. Fill dowel, anchor, and similar holes.

1. Clean soiled surfaces with fiber brush and soap powder and rinse thoroughly with clear water.
2. Wet joint surfaces thoroughly before applying mortar.
3. Rake out mortar joints for pointing with sealant.

D. Tool exposed joints slightly concave when thumbprint hard, using a jointer larger than joint thickness unless otherwise indicated.

E. Cut joints flush for masonry walls to receive plaster or other direct-applied finishes (other than paint) unless otherwise indicated.

F. Cut joints flush where indicated to receive waterproofing unless otherwise indicated.

3.6 INSTALLATION OF MASONRY-JOINT REINFORCEMENT

A. General: Install entire length of longitudinal side rods in mortar with a minimum cover of **5/8 inch** on exterior side of walls, **1/2 inch** elsewhere. Lap reinforcement a minimum of **6 inches**.

1. Space reinforcement not more than **16 inches** o.c.
2. Space reinforcement not more than **8 inches** o.c. in foundation walls and parapet walls.
3. Provide reinforcement not more than **8 inches** above and below wall openings and extending **12 inches** beyond openings .

B. Interrupt joint reinforcement at control and expansion joints unless otherwise indicated.

C. Provide continuity at wall intersections by using prefabricated T-shaped units.

D. Provide continuity at corners by using prefabricated L-shaped units.

3.7 ANCHORAGE OF MASONRY TO STRUCTURAL STEEL AND CONCRETE

A. Anchor masonry to structural steel and concrete, where masonry abuts or faces structural steel or concrete, to comply with the following:

1. Provide an open space not less than 1/2 inch wide between masonry and structural steel or

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concrete unless otherwise indicated. Keep open space free of mortar and other rigid materials.
2. Anchor masonry with anchors embedded in masonry joints and attached to structure.
3. Space anchors as indicated, but not more than **24 inches** o.c. vertically and **36 inches** o.c. horizontally.

3.8 INSTALLATION OF CONTROL JOINTS

A. General: Install control joint materials in CMUs as masonry progresses. Do not allow materials to span control joints without provision to allow for in-plane wall or partition movement.

B. Locate control joints. See Drawings and/or Comply with CMU-TEC-009-25.

C. Form control joints in CMUs as follows:

1. Fit bond-breaker strips into hollow contour in ends of CMUs on one side of control joint. Fill resultant core with grout and rake out joints in exposed faces for application of sealant.
2. Install preformed control joint gaskets designed to fit standard sash block.
3. Install interlocking units designed for control joints. Install bond-breaker strips at joint. Keep head joints free and clear of mortar or rake out joint for application of sealant.
4. Install temporary foam-plastic filler in head joints and remove filler when unit masonry is complete for application of sealant.

3.9 INSTALLATION OF LINTELS

A. Install lintels over openings as indicated.

B. Provide concrete or formed-in-place masonry lintels where shown and where openings of more than **12 inches** for brick-size units and **24 inches** for block-size units are shown without structural steel or other supporting lintels. Provide minimum bearing of **8 inches** at each jamb unless otherwise indicated.

C. Install loose steel over openings . See Drawings.

1. Provide minimum bearing of **8 inches** at each jamb unless otherwise indicated.

D. Lintels at Fire-Rated Openings: Provide fire-rated masonry required or steel lintels with applied fireproofing in thickness required to maintain fire rating of wall or partition rating.

3.10 INSTALLATION OF EMBEDDED FLASHING

A. General: Install embedded flashing at ledges and other obstructions to downward flow of water in wall where indicated.

B. Install flashing as follows unless otherwise indicated:

1. Prepare masonry surfaces so they are smooth and free from projections that could puncture flashing. Where flashing is within mortar joint, place through-wall flashing on sloping bed of mortar and cover with mortar. Before covering with mortar, seal penetrations in flashing with adhesive, sealant, or tape as recommended by flashing manufacturer.
2. At lintels, extend flashing a minimum of **6 inches** into masonry at each end. At heads and sills, extend flashing **6 inches** at ends and turn up not less than **2 inches** to form end dams.
3. Interlock end joints of ribbed sheet metal flashing by overlapping ribs not less than **1-1/2 inches** or as recommended by flashing manufacturer, and seal lap with elastomeric sealant complying with requirements in Section 079200 "Joint Sealants" for application indicated.
4. Install metal drip edges with ribbed sheet metal flashing by interlocking hemmed edges to form hooked seam. Seal seam with elastomeric sealant complying with requirements in Section 079200 "Joint Sealants" for application indicated.
5. Install metal drip edges beneath flexible flashing at exterior face of wall. Stop flexible flashing **1/2 inch** back from outside face of wall, and adhere flexible flashing to top of metal drip edge.
6. Install metal flashing termination beneath flexible flashing at exterior face of wall. Stop flexible flashing **1/2 inch** back from outside face of wall, and adhere flexible flashing to top of metal flashing termination.
7. Cut flexible flashing off flush with face of wall after masonry wall construction is completed.

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C. Install single-wythe CMU flashing system in bed joints of CMU walls where indicated to comply with manufacturer's written instructions. Install CMU cell pans with upturned edges located below face shells and webs of CMUs above and with weep spouts aligned with face of wall. Install CMU web covers so that they cover upturned edges of CMU cell pans at CMU webs and extend from face shell to face shell.

D. Install reglets and nailers for flashing and other related construction where they are shown to be built into masonry.

3.11 INSTALLATION OF REINFORCED UNIT MASONRY

A. Temporary Formwork and Shores: Construct formwork and shores as needed to support reinforced masonry elements during construction.

1. Construct formwork to provide shape, line, and dimensions of completed masonry as indicated. Make forms sufficiently tight to prevent leakage of mortar and grout. Brace, tie, and support forms to maintain position and shape during construction and curing of reinforced masonry.
2. Do not remove forms and shores until reinforced masonry members have hardened sufficiently to carry their own weight and other loads that may be placed on them during construction.

B. Placing Reinforcement: Comply with requirements in TMS 402/602.

C. Grouting: Do not place grout until entire height of masonry to be grouted has attained enough strength to resist grout pressure.

1. Comply with requirements in TMS 402/602 for cleanouts and for grout placement, including minimum grout space and maximum pour height.
2. Limit height of vertical grout pours to not more than 60 inches.

3.12 INSTALLATION OF MASONRY-CELL FILL

A. Loose-Fill Insulation: Pour into cavities to fill void spaces. Maintain inspection ports to show presence of fill at extremities of each pour area. Close the ports after filling has been confirmed. Limit the fall of fill to one story high, but not more than **20 ft.**.

B. Lightweight-Aggregate Fill: Pour into cavities to fill void spaces. Maintain inspection ports to show presence of fill at extremities of each pour area. Close the ports after filling has been confirmed. Limit the fall of fill to one story high, but not more than **20 ft.**.

C. Foamed-In-Place Masonry Cell Fill: Drill holes in mortar bed joints at spacing as indicated in writing by foamed-in-place masonry fill manufacturer, and inject foam to fill masonry cell voids.

3.13 FIELD QUALITY CONTROL

A. Testing Agency: Owner will engage a qualified testing agency to perform tests and inspections. Allow inspectors access to scaffolding and work areas as needed to perform tests and inspections. Retesting of materials that fail to comply with specified requirements is done at Contractor's expense.

B. Inspections: Special inspections in accordance with Level 2 in TMS 402/602.

1. Begin masonry construction only after inspectors have verified proportions of site-prepared mortar.
2. Place grout only after inspectors have verified compliance of grout spaces, grades, sizes, and locations of reinforcement.
3. Place grout only after inspectors have verified proportions of site-prepared grout.

C. Testing Prior to Construction: One set of tests.

D. Testing Frequency: One set of tests for each **5000 sq. ft.** of wall area or portion thereof.

E. Concrete Masonry Units: Test for each type of unit provided, in accordance with ASTM C140/C140M for compressive strength.

F. Mortar Aggregates: Ratio test (Proportion Specification) for each mix provided, in accordance with

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ASTM C780.

G. Mortar: Test for each mix provided, in accordance with ASTM C780. Test mortar for mortar air content and compressive strength.

H. Grout: Test for each mix provided, in accordance with ASTM C1019.

I. Prism Test: For each type of construction provided, in accordance with ASTM C1314 at 7 days and at 28 days.

J. Fire-Resistance-Rated Construction: Where applicable, inspect fire-rated CMU construction to determine compliance with construction documents per building code compliance.

3.14 PARGING

A. Parge exterior faces of below-grade masonry walls, where indicated, in two uniform coats to a total thickness of **3/4 inch**. Dampen wall before applying first coat, and scarify first coat to ensure full bond to subsequent coat.

B. Use a steel-trowel finish to produce a smooth, flat, dense surface with a maximum surface variation of **1/8 inch per foot**. Form a wash at top of parging and a cove at bottom.

C. Damp-cure parging for at least 24 hours and protect parging until cured.

3.15 REPAIRING AND POINTING

A. Remove and replace masonry units that are loose, chipped, broken, stained, or otherwise damaged or that do not match adjoining units. Install new units to match adjoining units; install in fresh mortar, pointed to eliminate evidence of replacement.

B. Pointing: During the tooling of joints, enlarge voids and holes, except weep holes, and completely fill with mortar. Point up joints, including corners, openings, and adjacent construction, to provide a neat, uniform appearance. Prepare joints for sealant application, where indicated.

3.16 CLEANING

A. In-Progress Cleaning: Clean unit masonry as Work progresses by dry brushing to remove mortar fins and smears before tooling joints.

B. Final Cleaning: After mortar is thoroughly set and cured, clean exposed masonry as follows:

1. Remove large mortar particles by hand with wooden paddles and nonmetallic scrape hoes or chisels.
2. Test cleaning methods on sample wall panel; leave one-half of panel uncleaned for comparison purposes. Obtain Architect's approval of sample cleaning before proceeding with cleaning of masonry.
3. Protect adjacent stone and nonmasonry surfaces from contact with cleaner by covering them with liquid-strippable masking agent or polyethylene film and waterproof masking tape.
4. Wet wall surfaces with water before applying cleaners; remove cleaners promptly by rinsing surfaces thoroughly with clear water.
5. Clean concrete masonry by applicable cleaning methods indicated in TEK 08-04A.

3.17 MASONRY WASTE DISPOSAL

A. Salvageable Materials: Unless otherwise indicated, excess masonry materials are Contractor's property. At completion of unit masonry work, remove from Project site.

B. Waste Disposal as Fill Material: Dispose of clean masonry waste, including excess or soil-contaminated sand, waste mortar, and broken masonry units, by crushing and mixing with fill material as fill is placed.

1. Crush masonry waste to less than **4 inches** in each dimension.
2. Mix masonry waste with at least 2 parts of specified fill material for each part of masonry waste.

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Fill material is specified in Section 312000 "Earth Moving."

3. Do not dispose of masonry waste as fill within **18 inches** of finished grade.

C. Masonry Waste Recycling: Return broken CMUs not used as fill to manufacturer for recycling.

D. Excess Masonry Waste: Remove excess clean masonry waste that cannot be used as fill, as described above or recycled, and other masonry waste, and legally dispose of off Owner's property.

END OF SECTION 04 22 00

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SECTION 04 26 13 - MASONRY VENEER

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Clay masonry units.
2. Mortar materials.
3. Ties and anchors.
4. Embedded flashing.
5. Mortar mixes.

B. Products Installed, but Not Furnished, under This Section:

1. Cast-stone trim in masonry veneer.
2. Stone trim units in masonry veneer.
3. Steel lintels in masonry veneer.
4. Steel shelf angles for supporting masonry veneer.

C. Related Requirements:

1. Section 033000 "Cast-in-Place Concrete" for dovetail slots or channel slots for masonry-veneer anchors.
2. Section 034500 "Precast Architectural Concrete" for thin brick veneer.
3. Section 042200 "Concrete Unit Masonry" for full-size, single-wythe CMU assemblies.
4. Section 051200 "Structural Steel Framing" for installing anchor sections of adjustable masonry anchors for connecting to structural-steel frame.
5. Section 072500 "Weather Barriers" for weather barriers part of masonry veneer assemblies.
6. Section 076200 "Sheet Metal Flashing and Trim" for exposed sheet metal flashing and for furnishing manufactured reglets installed in masonry joints.
7. Section 092900 "Gypsum Board" for exterior backer board part of masonry veneer assemblies.

1.2 DEFINITIONS

A. CMU(s): Concrete masonry unit(s).

B. Exposed: Weather-exposed side of a constructed wall.

1.3 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of specified product.

B. Shop Drawings: For the following:

1. Masonry Units: Indicate sizes, profiles, coursing, and locations of special shapes.
2. Fabricated Flashing: Detail corner units, end-dam units, and other special applications.

C. Samples for Initial Selection:

1. Hollow Clay Facing Brick: Small-scale units.
2. Colored Mortar: Full range of manufacturer's standard colors.
3. Aggregate for Mortar: Range of aggregate colors for colored-aggregate mortar.
4. Weep/cavity vents.

D. Samples for Verification: For each type and color of the following:

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1. Hollow Clay Facing Brick: Small-scale units.
2. Special Masonry Shapes: One of each unique shape.
3. Colored Mortar: Full range of manufacturer's standard colors.
4. Pigmented Mortar: Make Samples using same sand and mortar ingredients to be used on Project.
5. Colored-Aggregate Mortar: Make Samples using same sand and mortar ingredients to be used on Project.
6. Weep/cavity vents.
7. Cavity drainage material.
8. Accessories embedded in masonry.

1.5 INFORMATIONAL SUBMITTALS

A. List of Materials Used in Constructing Mockups: List generic product names together with manufacturers, manufacturers' product names, model numbers, lot numbers, batch numbers, source of supply, and other information as required to identify materials used. Include mix proportions for mortar and grout and include source of aggregates.

1. Submittal is for information only. Receipt of list does not constitute approval of deviations from the Contract Documents unless such deviations are specifically brought to attention of Architect and approved in writing.

B. Material Certificates: For each type and size of the following:

1. Masonry units.

a. Include material test reports substantiating compliance with requirements.
b. For brick, include size-variation data verifying that actual range of sizes falls within specified tolerances.
c. For exposed brick, include test report for efflorescence in accordance with ASTM C67/C67M.
d. For surface-coated brick, include test report for durability of surface appearance after 50 cycles of freezing and thawing in accordance with ASTM C67/C67M .

2. Integral water repellent used in decorative CMUs.
3. Cementitious Materials: Include name of manufacturer, brand name, and type.
4. Mortar admixtures.
5. Preblended, Dry Mortar Mixes: Include description of type and proportions of ingredients.
6. Anchors, ties, and metal accessories.

C. Mix Designs: For each type of mortar. Include description of type and proportions of ingredients.

1. Include test reports for mortar mixes required to comply with property specification. Test in accordance with ASTM C109/C109M for compressive strength, ASTM C1506 for water retention, and ASTM C91/C91M for air content.

D. Qualification Statements: For testing agency.

E. Weather Procedures: Detailed description of methods, materials, and equipment to be used to comply with requirements for [**cold**][**and**][**hot**] weather.

1.6 QUALITY ASSURANCE

A. Installer Qualifications: All masonry flashing installers must complete the International Masonry Institute Flashing Upgrade training course.

B. Testing Agency Qualifications: Qualified in accordance with ASTM C1093 for testing indicated.

1.7 MOCKUPS

A. Wall Mockups: Build mockups to demonstrate aesthetic effects and to set quality standards for installation.

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1. Build mockups for each type of exposed masonry veneer construction in sizes approximately 48 inches long by 48 inches high by full thickness, including face and backup wythes and accessories.

    a. Include a sealant-filled joint at least **16 inches** long in each mockup.
    b. Include lower corner of window opening at upper corner of exterior wall mockup. Make opening approximately **12 inches** wide by **16 inches** high.
    c. Include through-wall flashing installed for a **24-inch** length in corner of exterior wall mockup approximately **16 inches** down from top of mockup, with a **12-inch** length of flashing left exposed to view (omit masonry above half of flashing).
    d. Include wall substrate and cavity materials, veneer anchors, flashing , cavity drainage material, and weep holes in exterior masonry-veneer wall mockup.

2. Where masonry is to match existing, erect mockups adjacent and parallel to existing surface.
3. Clean one-half of exposed faces of mockups with masonry cleaner as indicated.
4. Protect accepted mockups from the elements with weather-resistant membrane.
5. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Owner specifically approves such deviations by Change Order.
6. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.8 DELIVERY, STORAGE, AND HANDLING

A. Store masonry units on elevated platforms in a dry location. If units are not stored in an enclosed location, cover tops and sides of stacks with waterproof sheeting, securely tied. If the units become wet, do not install until they are dry.

B. Store cementitious materials on elevated platforms, under cover, and in a dry location. Do not use cementitious materials that have become damp.

C. Store aggregates where grading and other required characteristics can be maintained and contamination avoided.

D. Deliver preblended, dry mortar mix in moisture-resistant containers. Store preblended, dry mortar mix in delivery containers on elevated platforms in a dry location or in covered weatherproof dispensing silos.

E. Store masonry accessories, including metal items, to prevent corrosion and accumulation of dirt and oil.

1.9 FIELD CONDITIONS

A. Protection of Masonry: During construction, cover tops of veneer, projections, and sills with waterproof sheeting at end of each day's work. Cover partially completed masonry when construction is not in progress.

    1. Extend cover a minimum of **24 inches** down face of veneer, and hold cover securely in place.

B. Stain Prevention: Prevent grout, mortar, and soil from staining the face of masonry. Immediately remove grout, mortar, and soil that come in contact with masonry.

    1. Protect base of walls from rain-splashed mud and from mortar splatter by spreading coverings on ground and over wall surface.
    2. Protect sills, ledges, and projections from mortar droppings.
    3. Protect surfaces of window and door frames, as well as similar products with painted and integral finishes, from mortar droppings.
    4. Turn scaffold boards near the wall on edge at the end of each day to prevent rain from splashing mortar and dirt onto completed masonry.

C. Cold-Weather Requirements: Do not use frozen materials or materials mixed or coated with ice or frost. Do not build on frozen substrates. Remove and replace masonry veneer damaged by frost or by freezing conditions. Comply with cold-weather construction requirements contained in TMS 402/602.

    1. Cold-Weather Cleaning: Use liquid cleaning methods only when air temperature is **40 deg F**

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and higher and will remain so until masonry has dried, but not less than seven days after completing cleaning.

D. Hot-Weather Requirements: Comply with hot-weather construction requirements contained in TMS 402/602.

PART 2 - PRODUCTS

2.1 SOURCE LIMITATIONS

A. Obtain exposed masonry units from single source.

2.2 MASONRY VENEER, GENERAL

A. Masonry Standard: Comply with TMS 402/602, except as modified by requirements in the Contract Documents.

B. Defective Units: Referenced masonry unit standards may allow a certain percentage of units to contain chips, cracks, or other defects exceeding limits stated. Do not use units where such defects will be exposed in the completed Work and will be within 20 ft. vertically and horizontally of a walking surface.

C. Fire-Resistance Ratings: Comply with requirements for fire-resistance-rated assembly designs indicated.

1. Where fire-resistance-rated construction is indicated, units are listed by UL or a qualified testing agency acceptable to authorities having jurisdiction.

2.3 CLAY MASONRY UNITS

A. General: Provide shapes indicated and as follows, with exposed surfaces matching finish and color of exposed faces of adjacent units.

1. For ends of sills and caps and for similar applications that would otherwise expose unfinished brick surfaces, provide units without cores or frogs and with exposed surfaces finished.
2. Provide special shapes for applications where stretcher units cannot accommodate special conditions, including corners, movement joints, bond beams, sashes, and lintels.

B. Hollow Clay Facing Brick: ASTM C652, Grade SW, Type HBS, Class H40V.

1. Basis-of-Design Product: Subject to compliance with requirements, provide The product indicated in the drawings or comparable product by one of the following:

   a. Acme Brick Company
   b. Belden Brick Company (The)
   c. Bilco Brick Company
   d. Echelon Masonry, an Oldcastle APG brand
   e. Endicott Clay Products Co
   f. General Shale, Inc.
   g. Glen-Gery Corporation

2. Initial Rate of Absorption: Less than **30 g/30 sq. in.** per minute when tested in accordance with ASTM C67/C67M.
3. Efflorescence: Provide brick that has been tested in accordance with ASTM C67/C67M and is rated "not effloresced."
4. Surface Coating: Brick with colors or textures produced by application of coatings withstand 50 cycles of freezing and thawing in accordance with ASTM C67/C67M with no observable difference in the applied finish when viewed from **10 ft.** or have a history of successful use in Project's area.
5. Size (Actual Dimensions): 3-5/8 inches wide by 2-1/4 inches high by 7-5/8 inches long.
6. Application: Use for exposed brick unless otherwise indicated.
7. Where indicated to "match existing," provide facing brick matching color range, texture, and size of existing adjacent brickwork.

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8. Color and Texture: As selected by Architect or as indicated in the drawings.

2.4 MORTAR MATERIALS

A. Portland Cement: ASTM C150/C150M, Type I or II, except Type III may be used for cold-weather construction. Provide natural color or white cement as required to produce mortar color indicated.

1. Alkali content will not be more than 0.1 percent when tested in accordance with ASTM C114.

B. Hydrated Lime: ASTM C207, Type S.

C. Portland Cement-Lime Mix: Packaged blend of portland cement and hydrated lime containing no other ingredients.

D. Masonry Cement: ASTM C91/C91M.

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. Argos USA LLC
b. Cemex S.A.B. de C.V.
c. Fairborn Cement Company
d. Federal White Cement, Ltd.
e. Heidelberg Materials
f. Lafarge North America Inc.
g. LafargeHolcim
h. Lehigh White Cement Company
i. Quikrete; The QUIKRETE Companies, LLC
j. Sakrete; CRH Americas, Oldcastle APG

E. Mortar Cement: ASTM C1329/C1329M.

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. Lafarge North America Inc.

F. Mortar Pigments: Natural and synthetic iron oxides and chromium oxides, compounded for use in mortar mixes and complying with ASTM C979/C979M. Use only pigments with a record of satisfactory performance in masonry mortar.

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. Davis Colors
b. Euclid Chemical Company (The); a subsidiary of RPM International, Inc.
c. Lanxess Corporation
d. Solomon Colors Inc.

G. Colored Mortar: Packaged blend made from masonry cement and mortar pigments, all complying with specified requirements, and containing no other ingredients.

1. Formulate blend as required to produce color indicated or, if not indicated, as selected from manufacturer's standard colors.
2. Pigments do not exceed 10 percent of portland cement by weight.
3. Pigments do not exceed 5 percent of masonry cement or mortar cement by weight.

H. Preblended Dry Mortar Mix: Packaged blend complying with ASTM C1714/C1714M.

I. Aggregate for Mortar: ASTM C144.

1. For mortar that is exposed to view, use washed aggregate consisting of natural sand or crushed stone.
2. For joints less than **1/4 inch** thick, use aggregate graded with 100 percent passing the **No. 16** sieve.

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3. White-Mortar Aggregates: Natural white sand or crushed white stone.
4. Colored-Mortar Aggregates: Natural sand or crushed stone of color necessary to produce required mortar color.

J. Cold-Weather Admixture: Nonchloride, noncorrosive, accelerating admixture, complying with ASTM C494/C494M, Type C, and recommended by manufacturer for use in masonry mortar of composition indicated.

1. 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. Euclid Chemical Company (The); a subsidiary of RPM International, Inc.
b. GCP Applied Technologies Inc.

K. Water-Repellent Admixture: Liquid water-repellent mortar admixture intended for use with CMUs containing integral water repellent from same manufacturer.

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. ACM Chemistries
b. Euclid Chemical Company (The); a subsidiary of RPM International, Inc.
c. GCP Applied Technologies Inc.
d. Master Builders Solutions

L. Water: Potable.

2.5 TIES AND ANCHORS

A. General: Ties and anchors extend at least **1-1/2 inches** into veneer but with at least a **5/8-inch** cover on outside face.

B. Materials: Provide ties and anchors specified in this article that are made from materials that comply with the following unless otherwise indicated:

1. Mill-Galvanized, Carbon Steel Wire: ASTM A1064/A1064M, with ASTM A641/A641M, Class 1 coating.
2. Hot-Dip Galvanized, Carbon Steel Wire: ASTM A1064/A1064M, with ASTM A153/A153M, Class B coating.
3. Stainless Steel Wire: ASTM A580/A580M, Type 304.
4. Galvanized-Steel Sheet: ASTM A653/A653M, Commercial Steel, **G60** zinc coating.
5. Steel Sheet, Galvanized after Fabrication: ASTM A1008/A1008M, Commercial Steel, with ASTM A153/A153M, Class B coating.
6. Stainless Steel Sheet: ASTM A240/A240M or ASTM A666, Type 304.

C. Adjustable Anchors for Connecting to Structural-Steel Framing: Provide anchors that allow vertical or horizontal adjustment but resist tension and compression forces perpendicular to plane of wall.

1. Anchor Section for Welding to Steel Frame: Crimped **1/4-inch-** diameter, hot-dip galvanized steel wire. Mill-galvanized wire may be used at interior walls unless otherwise indicated.
2. Tie Section: Triangular-shaped wire tie made from 0.25-inch- diameter, hot-dip galvanized steel wire. Mill-galvanized wire may be used at interior walls unless otherwise indicated.

D. Adjustable Anchors for Connecting to Concrete: Provide anchors that allow vertical or horizontal adjustment but resist tension and compression forces perpendicular to plane of wall.

1. Connector Section: Dovetail tabs for inserting into dovetail slots in concrete and attached to tie section; formed from 0.060-inch- thick, steel sheet, galvanized after fabrication.
2. Tie Section: Triangular-shaped wire tie made from 0.25-inch- diameter, hot-dip galvanized steel wire. Mill-galvanized wire may be used at interior walls unless otherwise indicated.
3. Corrugated-Metal Ties: Metal strips not less than **7/8 inch** wide with corrugations having a wavelength of **0.3 to 0.5 inch** and an amplitude of **0.06 to 0.10 inch** made from 0.0635-inch-thick steel sheet, galvanized after fabrication with dovetail tabs for inserting into dovetail slots in concrete.

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a. 0.064-inch- thick, galvanized sheet may be used at interior walls unless otherwise indicated.

E. Adjustable Masonry-Veneer Anchors:

1. General: Provide anchors that allow vertical adjustment but resist a **100 lbf** load in both tension and compression perpendicular to plane of wall without deforming or developing play in excess of **1/16 inch**.
2. Fabricate sheet metal anchor sections and other sheet metal parts from 0.0785-inch- thick steel sheet, galvanized after fabrication.
3. Fabricate wire ties from 0.25-inch- diameter, hot-dip galvanized steel wire unless otherwise indicated.
4. Contractor's Option: Unless otherwise indicated, provide any of the adjustable masonry-veneer anchors specified.
5. Masonry-Veneer Anchors; Vertical Slotted L-Plate: Rib-stiffened, sheet metal anchor section with screw holes at top and bottom, projecting vertical leg with slotted hole for wire tie and washer at face of insulation.

   a. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

      1) FERO Corporation
      2) Hohmann & Barnard, Inc
      3) PROSOCO, Inc
      4) Wire-Bond

6. Masonry-Veneer Anchors; Double-Pintle Plate: Rib-stiffened, sheet metal anchor section with screw holes at top and bottom, projecting horizontal leg with slots for vertical legs of double pintle wire tie.

   a. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

      1) Heckmann Building Products, Inc.
      2) Hohmann & Barnard, Inc
      3) Quality Steel and Wire LLC
      4) Wire-Bond

   b. Seismic: Provide seismic tie, clip, and continuous wire in veneer.

7. Masonry-Veneer Anchors; Slotted Plate: Sheet metal anchor section, with screw holes at top and bottom; and raised rib-stiffened strap, stamped into center to provide a slot between strap and base for wire tie. Use self-adhering tape to seal penetration behind anchor plate.

   a. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

      1) Heckmann Building Products, Inc.
      2) Hohmann & Barnard, Inc
      3) Quality Steel and Wire LLC
      4) Wire-Bond

8. Masonry-Veneer Anchors; Slotted Plate with Prongs: Sheet metal anchor section, with screw holes at top and bottom; top and bottom ends bent to form pronged legs of length to match thickness of insulation; and raised rib-stiffened strap, stamped into center to provide a slot between strap and base for wire tie. Use self-adhering tape to seal penetration behind anchor plate.

   a. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

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1) Hohmann & Barnard, Inc
2) Wire-Bond

9. Masonry-Veneer Anchors; Single-Barrel Screw: Self-drilling, single-barrel screw designed to receive wire tie. Screw has a smooth barrel the same thickness as insulation.

a. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1) Heckmann Building Products, Inc.
2) Hohmann & Barnard, Inc
3) PROSOCO, Inc
4) TRUFAST Walls
5) Wire-Bond

b. Factory Options: Provide factory-installed gasketed washer to seal at face of insulation and sheathing and a coating to reduce thermal conductivity.
c. Seismic: Provide with seismic tie, clip, and continuous wire in veneer.

10. Masonry-Veneer Anchors; Single-Barrel Screw with Double-Pintle Wingnut: Self-drilling, single-barrel screw with wingnut or clip designed to receive double-pintle wire tie. Screw has a smooth barrel the same thickness as insulation.

a. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1) Heckmann Building Products, Inc.
2) Hohmann & Barnard, Inc

b. Fastener Configuration: Single-barrel screw with thermally resistant wingnut head.
c. Factory Options: Provide factory-installed gasketed washer to seal at face of insulation and sheathing and a coating to reduce thermal conductivity.
d. Seismic: Provide with seismic tie, clip, and continuous wire in veneer.

11. Masonry-Veneer Anchors; Seismic-Pintle Plate: Rib-stiffened, sheet metal anchor section with screw holes at top and bottom, projecting leg with slotted hole for vertical leg of seismic pintle tie. Tie is rib-stiffened, sheet metal bent plate with down-turned leg to fit in anchor slot and with integral tabs to hold continuous wire in veneer.

a. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1) Hohmann & Barnard, Inc
2) Wire-Bond

12. Polymer-Coated, Steel Drill Screws for Steel Studs: ASTM C954 except manufactured with hex washer head and neoprene or EPDM washer, **No. 10** diameter by length required to penetrate steel stud flange with not less than three exposed threads, and with organic polymer coating with salt-spray resistance to red rust of more than 800 hours in accordance with ASTM B117.
13. Stainless Steel Drill Screws for Steel Studs: ASTM C954 except manufactured with hex washer head and neoprene or EPDM washer, **No. 10** diameter by length required to penetrate steel stud flange with not less than three exposed threads; either made from Type 410 stainless steel or made with a carbon steel drill point and 300 Series stainless steel shank.

2.6 EMBEDDED FLASHING

A. Metal Flashing: Provide metal flashing complying with SMACNA's "Architectural Sheet Metal Manual."

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. Cheney Flashing Company

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b. Hohmann & Barnard, Inc
c. Keystone Flashing Company, Inc
d. Wire-Bond

2. Stainless Steel: ASTM A240/A240M or ASTM A666, Type 304, **0.016 inch** thick.
3. Copper: ASTM B370, Temper H00, cold-rolled copper sheet, 16 oz./sq. ft. weight or 0.0216 inch thick.
4. Fabricate continuous flashings in sections **96 inches** long minimum, but not exceeding **12 ft.**. Provide splice plates at joints of formed, smooth metal flashing.
5. Fabricate through-wall flashing with drip edge unless otherwise indicated. Fabricate by extending flashing **1/2 inch** out from wall, with outer edge bent down 30 degrees and hemmed.
6. Fabricate through-wall flashing with sealant stop unless otherwise indicated. Fabricate by bending metal back on itself **3/4 inch** at exterior face of wall and down into joint **1/4 inch** to form a stop for retaining sealant backer rod.
7. Fabricate metal drip edges and sealant stops for sawtooth metal flashing from plain metal flashing of same metal as sawtooth flashing and extending at least **3 inches** into wall with hemmed inner edge to receive sawtooth flashing and form a hooked seam. Form hem on upper surface of metal so that completed seam sheds water.
8. Fabricate metal drip edges from stainless steel. Extend at least **3 inches** into wall and **1/2 inch** out from wall, with outer edge bent down 30 degrees [**and hemmed**].
9. Fabricate metal sealant stops from stainless steel. Extend at least **3 inches** into wall and out to exterior face of wall. At exterior face of wall, bend metal back on itself for **3/4 inch** and down into joint **1/4 inch** to form a stop for retaining sealant backer rod.
10. Fabricate metal expansion-joint strips from stainless steel to shapes indicated.
11. Solder metal items at corners.

B. Flexible Flashing: Where flashing is fully concealed in masonry, use one of the following unless otherwise indicated:

1. Copper Fabric Flashing: Copper sheet bonded between two layers of glass-fiber cloth. Use only where flashing is fully concealed in masonry.

a. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1) Advanced Building Products Inc.
2) Hohmann & Barnard, Inc
3) STS Coatings, Inc.
4) Wire-Bond
5) York Manufacturing, Inc

b. Sheet Weight: 3 oz./sq. ft..
c. Sheet Type: Self-adhesive.

2. Self-Adhering, Stainless Steel Fabric Flashing: Composite, flashing product consisting of minimum **2-mil** thick stainless steel sheet, bonded to a layer of polymeric fabric.

a. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1) Hohmann & Barnard, Inc
2) STS Coatings, Inc.
3) VaproShield LLC
4) Wire-Bond
5) York Manufacturing, Inc

b. Grade: Type 304.
c. Bonding Agent: Butyl adhesive.
d. Overall Thickness: Manufacturer's standard.

3. Rubberized-Asphalt Flashing: Composite flashing product consisting of a pliable, adhesive rubberized-asphalt compound, bonded to a high-density, cross-laminated polyethylene.

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a. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1) Advanced Building Products Inc.
2) Carlisle Construction Materials; Carlisle Companies
3) Fiberweb, a brand of Clark/Hammerbeam Corp.
4) GCP Applied Technologies Inc.
5) Heckmann Building Products, Inc.
6) Hohmann & Barnard, Inc
7) Polyguard Products, Inc.
8) W. R. Meadows, Inc
9) Williams Products, Inc.
10) Wire-Bond
11) York Manufacturing, Inc

b. Overall Thickness: Not less than 30 mils.

4. Butyl Rubber Flashing: Composite, self-adhesive, flashing product consisting of a pliable, butyl rubber compound, bonded to a high-density polyethylene film, aluminum foil, or spunbonded polyolefin.

a. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1) DuPont de Nemours, Inc.
2) GCP Applied Technologies Inc.
3) Kingspan Group
4) Protecto Wrap Company
5) Viaflex
6) Wire-Bond

b. Overall Thickness: Not less than 35 mils.

5. Elastomeric Thermoplastic Flashing: Composite flashing product consisting of a polyester-reinforced ethylene interpolymer alloy.

a. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1) Hohmann & Barnard, Inc
2) Hyload; IKO Industries, Inc.
3) Mortar Net Solutions
4) Wire-Bond

b. Monolithic Sheet: Elastomeric thermoplastic flashing, **40 mils** thick.
c. Self-Adhesive Sheet: Elastomeric thermoplastic flashing, **25 mils** thick, with a **15-mil-**thick coating of adhesive.

1) Color: Black.

6. EPDM Flashing: Sheet flashing product made from ethylene-propylene-diene terpolymer, complying with ASTM D4637/D4637M.

a. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1) Carlisle Construction Materials; Carlisle Companies
2) Elevate; Amrize Building Envelope LLC
3) Heckmann Building Products, Inc.
4) Hohmann & Barnard, Inc
5) Wire-Bond

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b. Thickness: **40 mils**.

C. Preformed Corners, End Dams, and Seaming Shapes for Flashing: Flashing manufacturer's standard products or products recommended by flashing manufacturer for waterproofing openings.

D. Solder and Sealants for Sheet Metal Flashings: As specified in Section 076200 "Sheet Metal Flashing and Trim."

1. Elastomeric Sealant: ASTM C920, chemically curing silicone sealant; of type, grade, class, and use classifications required to seal joints in sheet metal flashing and remain watertight.

E. Adhesives, Primers, and Seam Tapes for Flashings: Flashing manufacturer's standard products or products recommended by flashing manufacturer for bonding flashing sheets to each other and to substrates.

F. Termination Bars for Flexible Flashing:

1. Material: Stainless steel.
2. Size: 1/8 by 1 inch.

G. Termination Bars for Flexible Flashing, Flanged:

1. Material: Stainless steel sheet 0.019 by 1-1/2 inches.
2. Fabricate with a **3/8-inch** flange at top and bottom.

2.7 ACCESSORIES

A. Compressible Filler: Premolded filler strips complying with ASTM D1056, Grade 2A1; compressible up to 35 percent; of width and thickness indicated; formulated from neoprene.

B. Weep/Vent Products: Use the following unless otherwise indicated:

1. Wicking Material: Absorbent rope, made from cotton, **1/4 to 3/8 inch** in diameter, in length required to produce **2-inch** exposure on exterior and **18 inches** in cavity. Use only for weeps.
2. Round Plastic Weep/Vent Tubing: Medium-density polyethylene, **3/8-inch** OD by **4 inches** long.
3. Rectangular Plastic Weep/Vent Tubing: Clear butyrate, **3/8 by 1-1/2 by 3-1/2 inches** long.
4. Cellular Plastic Weep/Vent: One-piece, flexible extrusion made from UV-resistant polypropylene copolymer, full height and width of head joint and depth **1/8 inch** less than depth of outer wythe, in color selected from manufacturer's standard.

a. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1) Advanced Building Products Inc.
2) Heckmann Building Products, Inc.
3) Hohmann & Barnard, Inc
4) Mortar Net Solutions
5) Wire-Bond

5. Mesh Weep/Vent: Free-draining mesh; made from polyethylene strands, full height and width of head joint and depth **1/8 inch** less than depth of outer wythe; in color selected from manufacturer's standard.

a. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1) CavClear; a division of Archovations, Inc.
2) Hohmann & Barnard, Inc
3) Keene Building Products
4) Mortar Net Solutions

6. Vinyl Weep Hole/Vent: Units made from flexible PVC, designed to fit into a head joint and

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consisting of a louvered vertical leg, flexible wings to seal against ends of masonry units, and a top flap to keep mortar out of the head joint; in color selected by Architect.

a. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1) Hohmann & Barnard, Inc
2) Williams Products, Inc.
3) Wire-Bond

C. Cavity Drainage Material: Free-draining mesh, made from polymer strands that will not degrade within the wall cavity.

1. Mortar Deflector:

a. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1) Advanced Building Products Inc.
2) Hohmann & Barnard, Inc
3) Keene Building Products
4) Mortar Net Solutions
5) Wire-Bond
6) York Manufacturing, Inc

b. Size: Strips full depth of cavity and 16 inches high.
c. Surface Drainage: Dovetail-shaped notches that prevents clogging with mortar droppings.

D. Expanded Metal Lath: **3.4 lb/sq. yd.**, self-furring, diamond-mesh lath complying with ASTM C847. Fabricate from structural-quality, zinc-coated (galvanized) steel sheet complying with ASTM A653/A653M, **G60**.

E. Woven-Wire Lath: ASTM C1032/C1032M, fabricated into **1-1/2-inch** hexagonal-shaped mesh with minimum **0.0510-inch-** diameter, galvanized-steel wire.

F. Welded-Wire Lath: ASTM C933, fabricated into **2-by-2-inch** mesh with minimum **0.0625-inch-** diameter, galvanized-steel wire.

G. Lath Attachment Devices and Fasteners: Corrosion-resistant material and type required by ASTM C1063 for installations indicated.

H. Weep Screed: Fabricated from hot-dip galvanized steel sheet ASTM A653/ASTMA653M, **G60** zinc coating.

2.8 MORTAR MIXES

A. General: Do not use admixtures, including pigments, air-entraining agents, accelerators, retarders, water-repellent agents, antifreeze compounds, or other admixtures unless otherwise indicated.

1. Do not use calcium chloride in mortar or grout.
2. Use masonry cement or mortar cement mortar unless otherwise indicated.
3. Add cold-weather admixture (if used) at same rate for all mortar that will be exposed to view, regardless of weather conditions, to ensure that mortar color is consistent.

B. Preblended, Dry Mortar Mix: Furnish dry mortar ingredients in form of a preblended mix. Measure quantities by weight to ensure accurate proportions, and thoroughly blend ingredients before delivering to Project site.

C. Mortar for Masonry Veneer: Comply with ASTM C270, Proportion Specification. Use Type N unless another type is indicated.

1. For masonry below grade or in contact with earth, use Type M.

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D. Pigmented Mortar: Use colored cement product or select and proportion pigments with other ingredients to produce color required. Do not add pigments to colored mortar cement.

1. Pigments do not exceed 10 percent of portland cement by weight.
2. Pigments do not exceed 5 percent of masonry cement or mortar cement by weight.
3. Mix to match Architect's sample.
4. Application: Use pigmented mortar for exposed mortar joints.

E. Colored-Aggregate Mortar: Produce required mortar color by using colored aggregates and natural color or white cement as necessary to produce required mortar color.

1. Mix to match Architect's sample.
2. Application: Use colored-aggregate mortar for exposed mortar joints.

F. Thinset Mortar: Polymer-modified, thinset mortar per ANSI A118.4.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.

1. For the record, prepare written report, endorsed by Installer, listing conditions detrimental to performance of the Work.

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

3.2 INSTALLATION, GENERAL

A. Install all accessories in accordance with manufacturer's written instructions.

B. Leave openings for equipment to be installed before completing masonry. After installing equipment, complete masonry to match the construction immediately adjacent to opening.

C. Use full-size units without cutting if possible. If cutting is required to provide a continuous pattern or to fit adjoining construction, cut units with motor-driven saws; provide clean, sharp, unchipped edges. Allow units to dry before laying unless wetting of units is specified. Install cut units with cut surfaces and, where possible, cut edges concealed.

D. Select and arrange units for exposed masonry veneer to produce a uniform blend of colors and textures. Mix units from several pallets or cubes as they are placed.

E. Matching Existing Masonry: Match coursing, bonding, color, and texture of existing masonry.

F. Wetting of Brick: Wet brick before laying if initial rate of absorption exceeds **30 g/30 sq. in.** per minute when tested in accordance with ASTM C67/C67M. Allow units to absorb water so they are damp but not wet at time of laying.

3.3 TOLERANCES

A. Dimensions and Locations of Elements:

1. For dimensions in cross section or elevation, do not vary by more than plus **1/2 inch** or minus **1/4 inch**.
2. For location of elements in plan, do not vary from that indicated by more than plus or minus **1/2 inch**.
3. For location of elements in elevation, do not vary from that indicated by more than plus or minus **1/4 inch** in a story height or **1/2 inch** total.

B. Lines and Levels:

1. For bed joints and top surfaces of bearing walls, do not vary from level by more than **1/4 inch in 10 ft.**, or **1/2-inch** maximum.

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2. For conspicuous horizontal lines, such as lintels, sills, parapets, and reveals, do not vary from level by more than **1/8 inch in 10 ft.**, **1/4 inch in 20 ft.**, or **1/2-inch** maximum.
3. For vertical lines and surfaces, do not vary from plumb by more than **1/4 inch in 10 ft.**, **3/8 inch in 20 ft.**, or **1/2-inch** maximum.
4. For conspicuous vertical lines, such as external corners, door jambs, reveals, and expansion and control joints, do not vary from plumb by more than **1/8 inch in 10 ft.**, **1/4 inch in 20 ft.**, or **1/2-inch** maximum.
5. For lines and surfaces, do not vary from straight by more than **1/4 inch in 10 ft.**, **3/8 inch in 20 ft.**, or **1/2-inch** maximum.
6. For vertical alignment of exposed head joints, do not vary from plumb by more than **1/4 inch in 10 ft.**, or **1/2-inch** maximum.
7. For faces of adjacent exposed masonry units, do not vary from flush alignment by more than **1/16 inch** except due to warpage of masonry units within tolerances specified for warpage of units.

C. Joints:

1. For bed joints, do not vary from thickness indicated by more than plus or minus **1/8 inch**, with a maximum thickness limited to **1/2 inch**.
2. For exposed bed joints, do not vary from bed-joint thickness of adjacent courses by more than **1/8 inch**.
3. For head and collar joints, do not vary from thickness indicated by more than plus **3/8 inch** or minus **1/4 inch**.
4. For exposed head joints, do not vary from thickness indicated by more than plus or minus **1/8 inch**. Do not vary from adjacent bed-joint and head-joint thicknesses by more than 1/8 inch.
5. For exposed bed joints and head joints of stacked bond, do not vary from a straight line by more than **1/16 inch** from one masonry unit to the next.

3.4 INSTALLATION OF MASONRY WALLS

A. Lay out walls in advance for accurate spacing of surface bond patterns with uniform joint thicknesses and for accurate location of openings, movement-type joints, returns, and offsets. Avoid using less-than-half-size units, particularly at corners, jambs, and, where possible, at other locations.

B. Bond Pattern for Exposed Masonry: Unless otherwise indicated, lay exposed masonry in bond pattern indicated on Drawings; do not use units with less-than-nominal **4-inch** horizontal face dimensions at corners or jambs.

C. Stopping and Resuming Work: Stop work by stepping back units in each course from those in course below; do not tooth. When resuming work, clean masonry surfaces that are to receive mortar, remove loose masonry units and mortar, and wet brick if required before laying fresh masonry.

D. Built-in Work: As construction progresses, build in items specified in this and other Sections. Fill in solidly with masonry around built-in items.

E. Fill space between steel frames and masonry solidly with mortar unless otherwise indicated.

3.5 INSTALLATION OF MORTAR BEDDING AND JOINTING

A. Lay masonry units with face shells fully bedded in mortar and with head joints of depth equal to bed joints. At starting course, fully bed entire units, including area under cells.

1. At anchors and ties, fully bed units and fill cells with mortar as needed to fully embed anchors and ties in mortar.

B. Hollow Clay Facing Brick: Lay units with completely filled bed and head joints; butter ends with sufficient mortar to fill head joints and shove into place. Do not deeply furrow bed joints or slush head joints.

C. Solid Masonry Units: Lay units with completely filled bed and head joints; butter ends with sufficient mortar to fill head joints and shove into place. Do not deeply furrow bed joints or slush head joints.

D. Tool exposed joints slightly concave when thumbprint hard, using a jointer larger than joint thickness

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unless otherwise indicated.

1. For glazed masonry units, use a nonmetallic jointer **3/4 inch** or more in width.

3.6 INSTALLATION OF ANCHORED MASONRY VENEERS

A. Masonry-veneer anchors to comply with the following requirements:

1. Fasten screw-attached and seismic anchors through sheathing to wall framing and to concrete and masonry backup with metal fasteners of type indicated. Use two fasteners unless anchor design only uses one fastener.
2. Embed connector sections and continuous wire in masonry joints.
3. Locate anchor sections to allow maximum vertical differential movement of ties up and down.
4. Space anchors as indicated, but not more than **18 inches** o.c. vertically and **24 inches** o.c. horizontally, with not less than one anchor for each **2 sq. ft.** of wall area. Install additional anchors within **12 inches** of openings and at intervals, not exceeding **8 inches**, around perimeter.
5. Space anchors as indicated, but not more than **16 inches** o.c. vertically and **25 inches** o.c. horizontally, with not less than one anchor for each [**2.67 sq. ft.**][**3.5 sq. ft.**] of wall area. Install additional anchors within **12 inches** of openings and at intervals, not exceeding **36 inches**, around perimeter.
6. Space anchors as indicated, but not more than **18 inches** o.c. vertically and horizontally. Install additional anchors within **12 inches** of openings and at intervals, not exceeding **24 inches**, around perimeter.

B. Provide not less than 1 inch of airspace between back of masonry veneer and face of insulation.

1. Keep airspace clean of mortar droppings and other materials during construction. Bevel beds away from airspace, to minimize mortar protrusions into airspace. Do not attempt to trowel or remove mortar fins protruding into airspace.

3.7 INSTALLATION OF THE ANCHORING OF MASONRY TO STRUCTURAL STEEL AND CONCRETE

A. Anchor masonry to structural steel and concrete, where masonry abuts or faces structural steel or concrete to comply with the following:

1. Provide an open space not less than 1 inch wide between masonry and structural steel or concrete unless otherwise indicated. Keep open space free of mortar and other rigid materials.
2. Anchor masonry with anchors embedded in masonry joints and attached to structure.
3. Space anchors as indicated, but not more than **24 inches** o.c. vertically and **36 inches** o.c. horizontally.

3.8 INSTALLATION OF EXPANSION JOINTS

A. General: Install expansion-joint materials in masonry veneer as masonry progresses. Do not allow materials to span expansion joints without provision to allow for in-plane wall or partition movement.

B. Form expansion joints as follows:

1. Build flanges of metal expansion strips into masonry. Lap each joint **4 inches** in direction of water flow. Seal joints below grade and at junctures with horizontal expansion joints if any.
2. Build flanges of factory-fabricated, expansion-joint units into masonry.
3. Build in compressible joint fillers where indicated.
4. Form open joint full depth of brick wythe and of width indicated, but not less than 3/8 inch for installation of sealant and backer rod specified in Section 079200 "Joint Sealants."

C. Provide horizontal, pressure-relieving joints by either leaving an airspace or inserting a compressible filler of width required for installing sealant and backer rod specified in Section 079200 "Joint Sealants," but not less than 3/8 inch.

1. Locate horizontal, pressure-relieving joints beneath shelf angles supporting masonry.

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3.9 INSTALLATION OF OFFSET ANGLE SUPPORTS

A. Provide offset angle supports where indicate and where openings of more than **12 inches** for brick-size units and **24 inches** for block-size units are indicated without structural steel or other supporting lintels.

B. Provide minimum bearing of **8 inches** at each jamb unless otherwise indicated.

3.10 INSTALLATION OF EMBEDDED FLASHING

A. General: Install embedded flashing and weep holes in masonry at shelf angles, lintels, ledges, other obstructions to downward flow of water in wall, and where indicated. Install vents at shelf angles, ledges, and other obstructions to upward flow of air in cavities, and where indicated.

B. Install flashing as follows unless otherwise indicated:

1. Prepare masonry surfaces so they are smooth and free from projections that could puncture flashing. Where flashing is within mortar joint, place through-wall flashing on sloping bed of mortar and cover with mortar. Before covering with mortar, seal penetrations in flashing with adhesive, sealant, or tape as recommended by flashing manufacturer.
2. Extend flashing through veneer, across airspace behind veneer, and up face of sheathing at least **8 inches**; with upper edge tucked under water-resistive barrier, lapping at least **4 inches**.
3. At lintels and shelf angles, extend flashing **6 inches** minimum , to edge of next full unit at each end. At heads and sills, extend flashing **6 inches** minimum , to edge of next full unit and turn ends up not less than **2 inches** to form end dams.
4. Interlock end joints of sawtooth sheet metal flashing by overlapping ribs not less than **1-1/2 inches** or as recommended by flashing manufacturer, and seal lap with elastomeric sealant complying with requirements in Section 079200 "Joint Sealants" for application indicated.
5. Install metal drip edges and sealant stops with sawtooth sheet metal flashing by interlocking hemmed edges to form hooked seam. Seal seam with elastomeric sealant complying with requirements in Section 079200 "Joint Sealants" for application indicated.
6. Install metal drip edges beneath flexible flashing at exterior face of wall. Stop flexible flashing **1/2 inch** back from outside face of wall, and adhere flexible flashing to top of metal drip edge.
7. Install metal flashing termination beneath flexible flashing at exterior face of wall. Stop flexible flashing **1/2 inch** back from outside face of wall, and adhere flexible flashing to top of metal flashing termination.
8. Cut flexible flashing off flush with face of wall after masonry wall construction is completed.

C. Install reglets and nailers for flashing and other related construction where they are indicated to be built into masonry.

3.11 INSTALLATION OF WEEP/CAVITY VENTS

A. Install weep holes in veneers in head joints of first course of masonry immediately above embedded flashing.

1. Use specified weep/cavity vents to form weep holes.
2. Use wicking material to form weep holes above flashing under brick sills. Turn wicking down at lip of sill to be as inconspicuous as possible.
3. Space weep holes **24 inches** o.c. unless otherwise indicated.
4. Space weep holes formed from plastic tubing or **16 inches** o.c.
5. Cover cavity side of weep holes with plastic insect screening at cavities insulated with loose-fill insulation.
6. Trim wicking material flush with outside face of wall after mortar has set.

B. Place cavity drainage material in airspace behind veneers to comply with configuration requirements for cavity drainage material in "Accessories" Article.

C. Install vents in head joints in exterior wythes at spacing indicated. Use specified weep/cavity vent products to form vents.

1. Close cavities off vertically and horizontally with blocking in manner indicated. Install through-wall flashing and weep holes above horizontal blocking.

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3.12 FIELD QUALITY CONTROL

A. Testing Agency: Owner will engage a qualified testing agency to perform tests and inspections. Allow inspectors access to scaffolding and work areas as needed to perform tests and inspections. Retesting of materials that fail to comply with specified requirements will be at Contractor's expense.

B. Inspections: Special inspections in accordance with Level 2 in TMS 402/602.

1. Begin masonry construction only after inspectors have verified proportions of site-prepared mortar.

C. Mortar Aggregates: Ratio test (proportion specification) for each mix provided, in accordance with ASTM C780.

D. Mortar: Test each mix provided, in accordance with ASTM C780. Test mortar for mortar air content and compressive strength.

3.13 REPAIRING AND POINTING

A. Remove and replace masonry units that are loose, chipped, broken, stained, or otherwise damaged or that do not match adjoining units. Install new units to match adjoining units; install in fresh mortar, pointed to eliminate evidence of replacement.

B. Pointing: During the tooling of joints, enlarge voids and holes, except weep holes, and completely fill with mortar. Point up joints, including corners, openings, and adjacent construction, to provide a neat, uniform appearance. Prepare joints for sealant application, where indicated.

3.14 CLEANING

A. In-Progress Cleaning: Clean masonry veneer as work progresses by dry brushing to remove mortar fins and smears before tooling joints.

B. Final Cleaning: After mortar is thoroughly set and cured, clean exposed masonry as follows:

1. Remove large mortar particles by hand with wooden paddles and nonmetallic scrape hoes or chisels.
2. Test cleaning methods on sample wall panel; leave one-half of panel uncleaned for comparison purposes. Obtain Architect's approval of sample cleaning before proceeding with cleaning of masonry.
3. Protect adjacent stone and nonmasonry surfaces from contact with cleaner by covering them with liquid strippable masking agent or polyethylene film and waterproof masking tape.
4. Wet wall surfaces with water before applying cleaners; remove cleaners promptly by rinsing surfaces thoroughly with clear water.
5. Clean brick by bucket-and-brush hand-cleaning method described in BIA Technical Notes 20.
6. Clean masonry with a proprietary acidic cleaner applied in accordance with manufacturer's written instructions.

3.15 MASONRY WASTE DISPOSAL

A. Salvageable Materials: Unless otherwise indicated, excess masonry materials are Contractor's property. At completion of masonry veneer work, remove from Project site.

B. Waste Disposal as Fill Material: Dispose of clean masonry waste, including excess or soil-contaminated sand, waste mortar, and broken masonry units, by crushing and mixing with fill material as fill is placed.

1. Crush masonry waste to less than **4 inches** in each dimension.
2. Mix masonry waste with at least two parts of specified fill material for each part of masonry waste. Fill material is specified in Section 312000 "Earth Moving."
3. Do not dispose of masonry waste as fill within **18 inches** of finished grade.

C. Masonry Waste Recycling: Return broken masonry units not used as fill to manufacturer for recycling.

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D. Excess Masonry Waste: Remove excess clean masonry waste that cannot be used as fill, as described above or recycled, and other masonry waste, and legally dispose of off Owner's property.

END OF SECTION 04 26 13

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SECTION 05 12 00 - STRUCTURAL STEEL FRAMING

PART 1 - GENERAL

1.1 SUMMARY

A. Related Requirements:

1. Section 051213 "Architecturally Exposed Structural Steel Framing" for additional requirements for architecturally exposed structural steel.
2. Section 053100 "Steel Decking" for field installation of shear stud connectors through deck.
3. Section 055000 "Metal Fabrications" for steel lintels and shelf angles not attached to structural-steel frame, miscellaneous steel fabrications, and other steel items not defined as structural steel.
4. Section 099113 "Exterior Painting" and Section 099123 "Interior Painting" for painting requirements.

1.2 DEFINITIONS

A. Structural Steel: Elements of the structural frame indicated on Drawings and as described in ANSI/AISC 303.

B. Seismic-Load-Resisting System: Elements of structural-steel frame designated as "SLRS" or along grid lines designated as "SLRS" on Drawings, including columns, beams, and braces and their connections.

C. Heavy Sections: Rolled and built-up sections as follows:

1. Shapes included in ASTM A6/A6M with flanges thicker than **1-1/2 inches**.
2. Welded built-up members with plates thicker than **2 inches**.
3. Column base plates thicker than **2 inches**.

D. Protected Zone: Structural members or portions of structural members indicated as "protected zone" on Drawings. Connections of structural and nonstructural elements to protected zones are limited.

E. Demand-Critical Welds: Those welds, the failure of which would result in significant degradation of the strength and stiffness of the seismic-load-resisting system and which are indicated as "demand critical" or "seismic critical" on Drawings.

1.3 COORDINATION

A. Coordinate selection of shop primers with topcoats to be applied over them. Comply with paint and coating manufacturers' written recommendations to ensure that shop primers and topcoats are compatible with one another.

B. Coordinate installation of 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.

1.4 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1.5 ACTION SUBMITTALS

A. Product Data: For each type of specified product.

B. Shop Drawings: Show fabrication of structural-steel components.

1. Include details of cuts, connections, splices, camber, holes, and other pertinent data.

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2. Include embedment Drawings.
3. Indicate welds by standard AWS symbols, distinguishing between shop and field welds, and show size, length, and type of each weld. Show backing bars that are to be removed and supplemental fillet welds where backing bars are to remain.
4. Indicate type, size, and length of bolts, distinguishing between shop and field bolts. Identify pretensioned and slip-critical, high-strength bolted connections.
5. Identify members and connections of the seismic-load-resisting system.
6. Indicate locations and dimensions of protected zones.
7. Identify demand-critical welds.
8. Identify members not to be shop primed.

C. Welding Procedure Specifications (WPSs) and Procedure Qualification Records (PQRs): Provide in accordance with AWS D1.1/D1.1M for each welded joint qualified by testing, including the following:

1. Power source (constant current or constant voltage).
2. Electrode manufacturer and trade name, for demand-critical welds.

D. Delegated Design Submittals: For structural-steel connections indicated on Drawings to comply with design loads, include analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

1.6 INFORMATIONAL SUBMITTALS

A. Welding Certificates: For specified shop and field welding.

B. Paint Compatibility Certificates: From manufacturers of topcoats applied over shop primers, certifying that shop primers are compatible with topcoats.

C. Mill Test Reports: For structural-steel materials, including chemical and physical properties.

D. Product Test Reports: For the following:

1. Bolts, nuts, and washers, including mechanical properties and chemical analysis.
2. Direct-tension indicators.
3. Tension-control, high-strength, bolt-nut-washer assemblies.
4. Shear stud connectors.

E. Source Quality Control Reports: For structural-steel framing.

F. Field Quality Control Reports: For specified tests and inspections.

G. Qualification Statements: For Installer and fabricator.

1.7 QUALITY ASSURANCE

A. Fabricator Qualifications: A qualified fabricator that participates in the AISC Quality Certification Program and is designated an AISC-Certified Plant, Category BU or is accredited by the IAS Fabricator Inspection Program for Structural Steel (Acceptance Criteria 172).

B. Installer Qualifications: A qualified Installer who participates in the AISC Quality Certification Program and is designated an AISC-Certified Erector, Category CSE.

C. Shop-Painting Applicator Qualifications: Qualified in accordance with AISC's Sophisticated Paint Endorsement P1 or to SSPC-QP 3.

D. Welding Qualifications: Qualify procedures and personnel in accordance with AWS D1.1/D1.1M.

1. Welders and welding operators performing work on bottom-flange, demand-critical welds are to pass the supplemental welder qualification testing, as required by AWS D1.8/D1.8M. FCAW-S and FCAW-G are to be considered separate processes for welding personnel qualification.

1.8 DELIVERY, STORAGE, AND HANDLING

A. Store materials to permit easy access for inspection and identification. Keep steel members off ground

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and spaced by using pallets, dunnage, or other supports and spacers. Protect steel members and packaged materials from corrosion and deterioration.

1. Do not store materials on structure in a manner that might cause distortion, damage, or overload to members or supporting structures. Repair or replace damaged materials or structures as directed.

B. Store fasteners in a protected place in sealed containers with manufacturer's labels intact.

1. Fasteners may be repackaged provided Owner's testing and inspecting agency observes repackaging and seals containers.
2. Clean and relubricate bolts and nuts that become dry or rusty before use.
3. Comply with manufacturers' written recommendations for cleaning and lubricating ASTM F3125/F3125M, Grade F1852 bolt assemblies and for retesting bolt assemblies after lubrication.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Comply with applicable provisions of the following specifications and documents:

1. ANSI/AISC 303.
2. ANSI/AISC 341.
3. ANSI/AISC 360.
4. RCSC's "Specification for Structural Joints Using High-Strength Bolts."

B. Construction: Shear wall system.

2.2 STRUCTURAL-STEEL MATERIALS

A. Recycled Content of Steel Products: Postconsumer recycled content plus one-half of preconsumer recycled content not less than 25 percent.

B. W-Shapes: As Indicated in the General Structural Notes .

C. Channels, Angles, M-Shapes: As Indicated in the General Structural Notes .

D. Channels, Angles, S-Shapes: As Indicated in the General Structural Notes .

E. Plate and Bar: As Indicated in the General Structural Notes .

F. Cold-Formed Hollow Structural Sections: As Indicated in the General Structural Notes .

G. Steel Pipe: ASTM A53/A53M, Type E or Type S, Grade B.

1. Weight Class: Standard.
2. Finish: Black except where indicated to be galvanized.

H. Steel Castings: ASTM A216/A216M, Grade WCB, with supplementary requirement S11.

I. Steel Forgings: ASTM A668/A668M.

J. Welding Electrodes: Comply with AWS requirements.

2.3 BOLTS AND CONNECTORS

A. High-Strength Bolts, Nuts, and Washers: As Indicated in the General Structural Notes.

B. Shear Stud Connectors: ASTM A108, AISI C-1015 through C-1020, headed-stud type, cold-finished carbon steel; AWS D1.1/D1.1M, Type B.

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2.4 RODS

A. Unheaded Anchor Rods: As indicated in the General Structural Notes .

1. Configuration: As indicated in the General Structural Notes .
2. Finish: As indicated in the General Structural Notes .
3. Headed Anchor Rods: As indicated in the General Structural Notes

B. Headed Anchor Rods: .

1. Finish: As indicated in the General Structural Notes .

C. Threaded Rods: As indicated in the General Structural Notes .

1. Finish: As indicated in the General Structural Notes .

2.5 FORGED-STEEL STRUCTURAL HARDWARE

A. Clevises and Turnbuckles: Made from cold-finished carbon-steel bars, ASTM A108, AISI C-1035.

B. Eye Bolts and Nuts: Made from cold-finished carbon-steel bars, ASTM A108, AISI C-1030.

C. Sleeve Nuts: Made from cold-finished carbon-steel bars, ASTM A108, AISI C-1018.

2.6 PRIMER

A. Steel Primer:

1. Comply with Section 099113 "Exterior Painting" and Section 099123 "Interior Painting."
2. SSPC-Paint 23, latex primer.
3. Fabricator's standard lead- and chromate-free, nonasphaltic, rust-inhibiting primer complying with MPI#79 and compatible with topcoat.

B. Galvanized-Steel Primer: MPI#26.

1. Etching Cleaner: MPI#25, for galvanized steel.
2. Galvanizing Repair Paint: ASTM A780/A780M.

2.7 SHRINKAGE-RESISTANT GROUT

A. Metallic, Shrinkage-Resistant Grout: ASTM C1107/C1107M, factory-packaged, metallic aggregate grout, mixed with water to consistency suitable for application and a 30-minute working time.

B. Nonmetallic, Shrinkage-Resistant Grout: ASTM C1107/C1107M, factory-packaged, nonmetallic aggregate grout, noncorrosive and nonstaining, mixed with water to consistency suitable for application and a 30-minute working time.

2.8 FABRICATION

A. Structural Steel: Fabricate and assemble in shop to greatest extent possible. Fabricate in accordance with ANSI/AISC 303 and to ANSI/AISC 360.

1. Camber structural-steel members where indicated.
2. Fabricate beams with rolling camber up.
3. Identify high-strength structural steel in accordance with ASTM A6/A6M and maintain markings until structural-steel framing has been erected.
4. Mark and match-mark materials for field assembly.
5. Complete structural-steel assemblies, including welding of units, before starting shop-priming operations.

B. 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/D1.1M.

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C. Bolt Holes: Cut, drill, or punch standard bolt holes perpendicular to metal surfaces.

D. Finishing: Accurately finish ends of columns and other members transmitting bearing loads.

E. Cleaning: Clean and prepare steel surfaces that are to remain unpainted in accordance with SSPC-SP 1.

F. Shear Stud Connectors: Prepare steel surfaces as recommended by manufacturer of shear connectors. Weld using automatic end welding of headed-stud shear connectors in accordance with AWS D1.1/D1.1M and manufacturer's written instructions.

G. Steel Wall-Opening Framing: Select true and straight members for fabricating steel wall-opening framing to be attached to structural-steel frame. Straighten as required to provide uniform, square, and true members in completed wall framing. Build up welded framing, weld exposed joints continuously, and grind smooth.

H. Welded-Steel Door Frames: Build up welded-steel doorframes attached to structural-steel frame. Weld exposed joints continuously and grind smooth. Plug-weld fixed steel bar stops to frames. Secure removable stops to frames with countersunk machine screws, uniformly spaced not more than **10 inches** o.c. unless otherwise indicated on Drawings.

I. Holes: Provide holes required for securing other work to structural steel and for other work to pass through steel members.

1. Cut, drill, or punch holes perpendicular to steel surfaces. Do not thermally cut bolt holes or enlarge holes by burning.
2. Baseplate Holes: Cut, drill, mechanically thermal cut, or punch holes perpendicular to steel surfaces.
3. Weld threaded nuts to framing and other specialty items indicated to receive other work.

2.9 SHOP CONNECTIONS

A. High-Strength Bolts: Shop install high-strength bolts in accordance with RCSC's "Specification for Structural Joints Using High-Strength Bolts" for type of bolt and type of joint specified.

1. Joint Type: Snug tightened.

B. Weld Connections: Comply with AWS D1.1/D1.1M and AWS D1.8/D1.8M for tolerances, appearances, welding procedure specifications, weld quality, and methods used in correcting welding work.

1. Assemble and weld built-up sections by methods that maintain true alignment of axes without exceeding tolerances in ANSI/AISC 303 for mill material.

2.10 GALVANIZING

A. Hot-Dip Galvanized Finish: Apply zinc coating by the hot-dip process to structural steel in accordance with ASTM A123/A123M.

1. Fill vent and drain holes that are exposed in the finished Work unless they function as weep holes, by plugging with zinc solder and filing off smooth.
2. Galvanize lintels attached to structural-steel frame and located in exterior walls.

2.11 SHOP PRIMING

A. Shop prime steel surfaces, except the following:

1. Surfaces embedded in concrete or mortar. Extend priming of partially embedded members to a depth of **2 inches**.
2. Surfaces to be field welded.
3. Surfaces of high-strength bolted, slip-critical connections.
4. Surfaces to receive sprayed fire-resistive materials (applied fireproofing).
5. Galvanized surfaces unless indicated to be painted.
6. Corrosion-resisting (weathering) steel surfaces.

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7. Surfaces enclosed in interior construction.

B. Surface Preparation of Steel: Clean surfaces to be painted. Remove loose rust and mill scale and spatter, slag, or flux deposits. Prepare surfaces in accordance with the following specifications and standards:

1. SSPC-SP 2.
2. SSPC-SP 3.

C. Surface Preparation of Galvanized Steel: Prepare galvanized-steel surfaces for shop priming by thoroughly cleaning steel of grease, dirt, oil, flux, and other foreign matter, and treating with etching cleaner or in accordance with SSPC-SP 16.

D. Priming: Immediately after surface preparation, apply primer in accordance with manufacturer's written instructions and at rate recommended by SSPC to provide a minimum dry film thickness of **1.5 mils**. Use priming methods that result in full coverage of joints, corners, edges, and exposed surfaces.

1. Stripe paint corners, crevices, bolts, welds, and sharp edges.
2. Apply two coats of shop paint to surfaces that are inaccessible after assembly or erection. Change color of second coat to distinguish it from first.

2.12 SOURCE QUALITY CONTROL

A. Testing Agency: Owner will engage a qualified testing agency to perform shop tests and inspections.

1. Allow testing agency access to places where structural-steel work is being fabricated or produced to perform tests and inspections.
2. Bolted Connections: Inspect shop-bolted connections in accordance with RCSC's "Specification for Structural Joints Using High-Strength Bolts."
3. Welded Connections: Visually inspect shop-welded connections in accordance with AWS D1.1/D1.1M and the following inspection procedures, at testing agency's option:

   a. Liquid Penetrant Inspection: ASTM E165/E165M.
   b. Magnetic Particle Inspection: ASTM E709; performed on root pass and on finished weld. Cracks or zones of incomplete fusion or penetration are not accepted.
   c. Ultrasonic Inspection: ASTM E164.
   d. Radiographic Inspection: ASTM E94/E94M.

4. In addition to visual inspection, test and inspect shop-welded shear stud connectors in accordance with requirements in AWS D1.1/D1.1M for stud welding and as follows:

   a. Perform bend tests if visual inspections reveal either a less-than-continuous 360-degree flash or welding repairs to any shear stud connector.
   b. Conduct tests in accordance with requirements in AWS D1.1/D1.1M on additional shear stud connectors if weld fracture occurs on shear stud connectors already tested.

5. Prepare test and inspection reports.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verify, with certified steel erector present, elevations of concrete- and masonry-bearing surfaces and locations of anchor rods, bearing plates, and other embedments for compliance with requirements.

1. Prepare a certified survey of existing conditions. Include bearing surfaces, anchor rods, bearing plates, and other embedments showing dimensions, locations, angles, and elevations.

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

3.2 PREPARATION

A. Provide temporary shores, guys, braces, and other supports during erection to keep structural steel

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secure, plumb, and in alignment against temporary construction loads and loads equal in intensity to design loads. Remove temporary supports when permanent structural steel, connections, and bracing are in place unless otherwise indicated on Drawings.

1. Do not remove temporary shoring supporting composite deck construction and structural-steel framing until cast-in-place concrete has attained its design compressive strength.

3.3 ERECTION OF STRUCTURAL-STEEL FRAMING

A. Set structural steel accurately in locations and to elevations indicated and in accordance with ANSI/AISC 303 and ANSI/AISC 360.

B. Baseplates, Bearing Plates, and Leveling Plates: Clean concrete- and masonry-bearing surfaces of bond-reducing materials, and roughen surfaces prior to setting plates. Clean bottom surface of plates.

1. Set plates for structural members on wedges, shims, or setting nuts as required.
2. Weld plate washers to top of baseplate.
3. Rods: Snug-tighten anchor rods after supported members have been positioned and plumbed. Do not remove wedges or shims but, if protruding, cut off flush with edge of plate before packing with grout.
4. Shrinkage-Resistant Grout: Promptly pack shrinkage-resistant grout solidly between bearing surfaces and plates, so no voids remain. Neatly finish exposed surfaces; protect grout and allow to cure. Comply with manufacturer's written installation instructions for grouting.

C. Maintain erection tolerances of structural steel within ANSI/AISC 303.

D. Align and adjust various members that form part of complete frame or structure before permanently fastening. Before assembly, clean bearing surfaces and other surfaces that are in permanent contact with members. Perform necessary adjustments to compensate for discrepancies in elevations and alignment.

1. Level and plumb individual members of structure. Slope roof framing members to slopes indicated on Drawings.
2. Make allowances for difference between temperature at time of erection and mean temperature when structure is completed and in service.

E. Splice members only where indicated.

F. Do not use thermal cutting during erection .

G. Do not enlarge unfair holes in members by burning or using drift pins. Ream holes that must be enlarged to admit bolts.

3.4 FIELD CONNECTIONS

A. High-Strength Bolts: Install high-strength bolts in accordance with RCSC's "Specification for Structural Joints Using High-Strength Bolts" for bolt and joint type specified.

1. Joint Type: Snug tightened or as indicated in the general structural notes and structural details .

B. Weld Connections: Comply with AWS D1.1/D1.1M and AWS D1.8/D1.8M for tolerances, appearances, welding procedure specifications, weld quality, and methods used in correcting welding work.

1. Comply with ANSI/AISC 303 and ANSI/AISC 360 for bearing, alignment, adequacy of temporary connections, and removal of paint on surfaces adjacent to field welds.
2. Remove backing bars or runoff tabs where indicated, back gouge, and grind steel smooth.
3. Assemble and weld built-up sections by methods that maintain true alignment of axes without exceeding tolerances in ANSI/AISC 303 for mill material.

C. Shear Stud Connectors: Prepare steel surfaces as recommended by manufacturer of shear connectors. Weld using end welding of headed-stud shear connectors in accordance with AWS D1.1/D1.1M and manufacturer's written instructions.

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3.5 REPAIR

A. Galvanized Surfaces: Clean areas where galvanizing is damaged or missing, and repair galvanizing to comply with ASTM A780/A780M.

B. Touchup Painting:

1. Immediately after erection, clean exposed areas where primer is damaged or missing, and paint with the same material as used for shop painting to comply with SSPC-PA 1 for touching up shop-painted surfaces.

   a. Clean and prepare surfaces by SSPC-SP 2 hand-tool cleaning or SSPC-SP 3 power-tool cleaning.

2. Cleaning and touchup painting are specified in Section 099113 "Exterior Painting." Section 099123 "Interior Painting."

3.6 FIELD QUALITY CONTROL

A. Special Inspections: Owner will engage a special inspector to perform the following special inspections:

1. Verify structural-steel materials and inspect steel frame joint details.
2. Verify weld materials and inspect welds.
3. Verify connection materials and inspect high-strength bolted connections.

B. Testing Agency: Owner will engage a qualified testing agency to perform tests and inspections.

1. Bolted Connections: Inspect bolted connections in accordance with RCSC's "Specification for Structural Joints Using High-Strength Bolts."
2. Welded Connections: Visually inspect field welds in accordance with AWS D1.1/D1.1M.

   a. In addition to visual inspection, test and inspect field welds in accordance with AWS D1.1/D1.1M and the following inspection procedures, at testing agency's option:

      1) Liquid Penetrant Inspection: ASTM E165/E165M.
      2) Magnetic Particle Inspection: ASTM E709; performed on root pass and on finished weld. Cracks or zones of incomplete fusion or penetration are not accepted.
      3) Ultrasonic Inspection: ASTM E164.
      4) Radiographic Inspection: ASTM E94/E94M.

3. Shear Stud Connectors: In addition to visual inspection, test and inspect field-welded shear connectors according to requirements in AWS D1.1/D1.1M for stud welding and as follows:

   a. Perform bend tests if visual inspections reveal either a less-than-continuous 360-degree flash or welding repairs to any shear connector.
   b. Conduct tests according to requirements in AWS D1.1/D1.1M on additional shear connectors if weld fracture occurs on shear connectors already tested.

END OF SECTION 05 12 00

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SECTION 05 50 00 - METAL FABRICATIONS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Metal ladders.
2. Metal ships' ladders.
3. Metal bollards.
4. Loose bearing and leveling plates.

B. Products Furnished, but Not Installed, under This Section:

1. Loose steel lintels.
2. Steel Weld Plates and Angles: For casting into concrete for applications where they are not specified in other Sections.
3. Cast-in-Place Anchors in Concrete: Anchor bolts, steel pipe sleeves, slotted-channel inserts, and wedge-type inserts indicated to be cast into concrete or built into unit masonry.

C. Related Requirements:

1. Section 042000 "Unit Masonry" for installing loose lintels, anchor bolts, and other items built into unit masonry.
2. Section 051200 "Structural Steel Framing" for steel framing, supports, elevator machine beams, hoist beams, divider beams, door frames, and other steel items attached to the structural-steel framing.
3. Section 077200 "Roof Accessories" for manufactured metal roof walkways and metal roof stairs.

1.2 COORDINATION

A. Coordinate selection of shop primers with topcoats to be applied over them. Comply with paint and coating manufacturers' written instructions to ensure that shop primers and topcoats are compatible with one another.

B. Coordinate installation of metal fabrications that are anchored to or that receive other work. 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.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of specified product.

B. Shop Drawings: Show fabrication and installation details. Include plans, elevations, sections, and details of metal fabrications and their connections. Show anchorage and accessory items. Provide for the following:

1. Miscellaneous Framing and Supports: For applications where framing and supports are not specified in other Sections.
2. Shelf angles.
3. Metal ladders.
4. Metal ships' ladders.
5. Metal pipe crossovers.
6. Elevator pit sump covers.
7. Structural-steel door frames.
8. Metal bollards.
9. Loose steel lintels.
10. Vehicular barrier cable systems.

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C. Samples for Verification: For each type and finish of extruded nosing and tread.

D. Delegated Design Submittals: For metal ladders, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

1.4 INFORMATIONAL SUBMITTALS

A. Welding certificates.

B. Paint Compatibility Certificates: From manufacturers of topcoats applied over shop primers, certifying that shop primers are compatible with topcoats.

C. Research Reports: For post-installed anchors.

D. Delegated design engineer qualifications.

1.5 QUALITY ASSURANCE

A. Welding Qualifications: Qualify procedures and personnel in accordance with the following welding codes:

1. AWS D1.1/D1.1M, "Structural Welding Code - Steel."
2. AWS D1.2/D1.2M, "Structural Welding Code - Aluminum."
3. AWS D1.6/D1.6M, "Structural Welding Code - Stainless Steel."

1.6 FIELD CONDITIONS

A. Field Measurements: Verify actual locations of walls, floor slabs, decks, and other construction contiguous with metal fabrications by field measurements before fabrication.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Delegated Design: Engage a qualified professional engineer, as defined in Section 014000 "Quality Requirements," to design metal ladders.

B. Structural Performance of Metal Ladders: Ladders , including landings, are to withstand the effects of loads and stresses within limits and under conditions specified in ANSI/ASC A14.3.

C. Structural Performance of Alternating Tread Devices: Alternating tread devices are to withstand the effects of gravity loads and the following loads and stresses within limits and under conditions indicated:

1. Uniform Load: **100 lbf/sq. ft.**.
2. Concentrated Load: **300 lbf** applied on an area of **4 sq. in.**.
3. Uniform and concentrated loads need not be assumed to act concurrently.
4. Alternating Tread Device Framing: Capable of withstanding stresses resulting from railing loads in addition to loads specified above.
5. Comply with applicable railing loadings in Section 055213 "Pipe and Tube Railings."

D. 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 METAL MATERIALS

A. Metal Surfaces, General: Provide materials with smooth, flat surfaces unless otherwise indicated. For metal fabrications exposed to view in the completed Work, provide materials without seam marks, roller marks, rolled trade names, or blemishes.

B. Steel Plates, Shapes, and Bars: ASTM A36/A36M.

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C. Stainless Steel Sheet, Strip, and Plate: ASTM A240/A240M or ASTM A666, Type 304.

D. Stainless Steel Bars and Shapes: ASTM A276/A276M, Type 304.

E. Steel Tubing: ASTM A500/A500M, cold-formed steel tubing.

F. Steel Pipe: ASTM A53/A53M, Standard Weight (Schedule 40) unless otherwise indicated.

G. Zinc-Coated Steel Wire Rope: ASTM A741.

1. Wire Rope Fittings: Hot-dip galvanized-steel connectors with capability to sustain, without failure, a load equal to minimum breaking strength of wire rope with which they are used.

H. Stainless Steel Wire Rope: Wire rope manufactured from stainless steel wire complying with ASTM A492, Type 316.

1. Wire Rope Fittings: Stainless steel connectors, Type 316, with capability to sustain, without failure, a load equal to minimum breaking strength of wire rope with which they are used.

I. Steel Prestressing Strand: ASTM A416/A416M, **Grade 270**, low-relaxation, seven-wire, with **0.9 lb/sq. ft.** zinc coating.

1. Steel Prestressing Strand Fittings: Hot-dip galvanized-steel anchors and connectors with capability to sustain, without failure, a load equal to minimum breaking strength of steel prestressing strand with which they are used.

J. Cast Iron: Either gray iron, ASTM A48/A48M, or malleable iron, ASTM A47/A47M, unless otherwise indicated.

K. Aluminum Plate and Sheet: **ASTM B209**, Alloy 6061-T6.

L. Aluminum Extrusions: **ASTM B221**, Alloy 6063-T6.

M. Aluminum Castings: ASTM B26/B26M, Alloy 443.0-F.

N. Bronze Extrusions: ASTM B455, Alloy UNS No. C38500 (extruded architectural bronze).

O. Bronze Castings: ASTM B584, Alloy UNS No. C83600 (leaded red brass) or UNS No. C84400 (leaded semired brass).

P. Nickel Silver Extrusions: ASTM B151/B151M, Alloy UNS No. C74500.

Q. Nickel Silver Castings: ASTM B584, Alloy UNS No. C97600 (20 percent leaded nickel bronze).

2.3 FASTENERS

A. Fasteners, General: Unless otherwise indicated, provide Type 304 stainless steel fasteners for exterior use and zinc-plated fasteners with coating complying with ASTM B633 or ASTM F1941/F1941M, Class Fe/Zn 5, at exterior walls. Select fasteners for type, grade, and class required.

1. Provide stainless steel fasteners for fastening aluminum , stainless steel or nickel silver.
2. Provide bronze fasteners for fastening bronze.

B. Steel Bolts and Nuts: Regular hexagon-head bolts, **ASTM A307, Grade A**; with hex nuts, **ASTM A563**; and, where indicated, flat washers.

C. Steel High-Strength Bolts, Nuts, and Washers: ASTM F3125/F3125M, **Grade A325**, Type 3, heavy-hex steel structural bolts; **ASTM A563, Grade DH3,** heavy-hex carbon-steel nuts; and where indicated, flat washers.

D. Stainless Steel Bolts and Nuts: Regular hexagon-head annealed stainless steel bolts, **ASTM F593**; with hex nuts, **ASTM F594**; and, where indicated, flat washers; Alloy Group 1.

E. Steel Anchor Bolts: ASTM F1554, Grade 36, of dimensions indicated; with nuts, **ASTM A563**; and, where indicated, flat washers.

1. Hot-dip galvanize or provide mechanically deposited, zinc coating where item being fastened is

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indicated to be galvanized.

F. Anchors, General: Capable of sustaining, without failure, a load equal to six times the load imposed when installed in unit masonry and four times the load imposed when installed in concrete, as determined by testing in accordance with ASTM E488/E488M, conducted by a qualified independent testing agency.

G. Cast-in-Place Anchors in Concrete: Either threaded or wedge type unless otherwise indicated; galvanized ferrous castings, either ASTM A47/A47M malleable iron or ASTM A27/A27M cast steel. Provide bolts, washers, and shims as needed, all hot-dip galvanized per ASTM F2329/F2329M.

H. Post-Installed Anchors: Torque-controlled expansion anchors or chemical anchors.

1. Material for Interior Locations: Carbon-steel components zinc plated to comply with ASTM B633 or ASTM F1941/F1941M, Class Fe/Zn 5, unless otherwise indicated.
2. Material for Exterior Locations and Where Stainless Steel Is Indicated: Alloy Group 1 stainless steel bolts, **ASTM F593**, and nuts, **ASTM F594**.

2.4 MISCELLANEOUS MATERIALS

A. Shop Primers: Provide primers that comply with Section 099113 "Exterior Painting." Section 099123 "Interior Painting."

B. Universal Shop Primer: Fast-curing, lead- and chromate-free, universal modified-alkyd primer complying with MPI#79 and compatible with topcoat.

1. Use primer that contains pigments that make it easily distinguishable from zinc-rich primer.

C. Water-Based Primer: Emulsion-type, anticorrosive primer for mildly corrosive environments that is resistant to flash rusting when applied to cleaned steel, complying with MPI#107 and compatible with topcoat.

D. Epoxy Zinc-Rich Primer: Complying with MPI#20 and compatible with topcoat.

E. Shop Primer for Galvanized Steel: Primer formulated for exterior use over zinc-coated metal and compatible with finish paint systems indicated.

F. Galvanizing Repair Paint: High-zinc-dust-content paint complying with SSPC-Paint 20 and compatible with paints specified to be used over it.

G. Bituminous Paint: Cold-applied asphalt emulsion complying with ASTM D1187/D1187M.

H. Shrinkage-Resistant Grout: Factory-packaged, nonmetallic, nonstaining, noncorrosive, nongaseous grout complying with ASTM C1107/C1107M. Provide grout specifically recommended by manufacturer for interior and exterior applications.

I. Concrete: Comply with requirements in Section 033000 "Cast-in-Place Concrete" for normal-weight, air-entrained concrete with a minimum 28-day compressive strength of **3000 psi**.

2.5 FABRICATION OF METAL, GENERAL

A. Shop Assembly: Preassemble items in the shop to greatest extent possible. Disassemble units only as necessary for shipping and handling limitations. Use connections that maintain structural value of joined pieces. Clearly mark units for reassembly and coordinated installation.

B. Cut, drill, and punch metals cleanly and accurately. Remove burrs and ease edges to a radius of approximately **1/32 inch** unless otherwise indicated. Remove sharp or rough areas on exposed surfaces.

C. Form bent-metal corners to smallest radius possible without causing grain separation or otherwise impairing work.

D. Form exposed work with accurate angles and surfaces and straight edges.

E. Weld corners and seams continuously to comply with the following:

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1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
2. Obtain fusion without undercut or overlap.
3. Remove welding flux immediately.
4. At exposed connections, finish exposed welds and surfaces smooth and blended so no roughness shows after finishing and contour of welded surface matches that of adjacent surface.

F. Form exposed connections with hairline joints, flush and smooth, using concealed fasteners or welds where possible. Where exposed fasteners are required, use Phillips flat-head (countersunk) fasteners unless otherwise indicated. Locate joints where least conspicuous.

G. Fabricate seams and other connections that are exposed to weather in a manner to exclude water. Provide weep holes where water may accumulate.

H. Cut, reinforce, drill, and tap metal fabrications as indicated to receive finish hardware, screws, and similar items.

I. Provide for anchorage of type indicated; coordinate with supporting structure. Space anchoring devices to secure metal fabrications rigidly in place and to support indicated loads.

J. Where units are indicated to be cast into concrete or built into masonry, equip with integrally welded steel strap anchors, **1/8 by 1-1/2 inches**, with a minimum **6-inch** embedment and **2-inch** hook, not less than **8 inches** from ends and corners of units and **24 inches** o.c., unless otherwise indicated.

2.6 MISCELLANEOUS FRAMING AND SUPPORTS

A. Miscellaneous Framing and Supports, General: Provide steel framing and supports not specified in other Sections as needed to complete the Work.

B. Fabricate units from steel shapes, plates, and bars of welded construction unless otherwise indicated. Fabricate to sizes, shapes, and profiles indicated and as necessary to receive adjacent construction.

1. Fabricate units from slotted channel framing where indicated.
2. Furnish inserts for units installed after concrete is placed.

C. Galvanize miscellaneous framing and supports where indicated.

D. Prime miscellaneous framing and supports with zinc-rich primer where indicated.

2.7 SHELF ANGLES

A. Galvanize and prime shelf angles located in exterior walls.

B. Prime shelf angles located in exterior walls with zinc-rich primer.

1. Furnish wedge-type concrete inserts, complete with fasteners, to attach shelf angles to cast-in-place concrete.

2.8 METAL LADDERS

A. Metal Ladders, General:

1. Comply with ANSI/ASC A14.3 , except for elevator pit ladders.
2. For elevator pit ladders, comply with ASME A17.1/CSA B44.

B. Steel Ladders :

1. Space siderails 16 inches apart unless otherwise indicated.
2. Siderails: Continuous, 1/2-by-2-1/2-inch steel flat bars, with eased edges.
3. Rungs: 3/4-inch- diameter, steel bars.
4. Fit rungs in centerline of siderails; plug-weld and grind smooth on outer rail faces.
5. Provide nonslip surfaces on top of each rung, either by coating rung with aluminum-oxide granules set in epoxy-resin adhesive or by using a type of manufactured rung filled with

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aluminum-oxide grout.
6. Source Limitations: Obtain nonslip surfaces from single source from single manufacturer.
7. Provide platforms as indicated, fabricated from welded or pressure-locked steel bar grating, supported by steel angles. Limit openings in gratings to no more than 3/4 inch in least dimension.
8. Support each ladder at top and bottom and not more than 60 inches o.c. with welded or bolted steel brackets.
9. Galvanize and prime exterior ladders, including brackets.
10. Prime exterior ladders, including brackets and fasteners, with zinc-rich primer.

C. Aluminum Ladders:

2.9 ALTERNATING TREAD DEVICES

A. Galvanize and prime exterior steel alternating tread devices, including treads, railings, brackets, and fasteners.

B. Prime exterior steel alternating tread devices, including treads, railings, brackets, and fasteners, with zinc-rich primer.

2.10 METAL SHIPS' LADDERS

A. Metal Ships' Ladders : Provide metal ships' ladders where indicated. Fabricate of open-type construction with channel or plate stringers and pipe and tube railings unless otherwise indicated. Provide brackets and fittings for installation.

1. Treads are not to be less than **5 inches** exclusive of nosing or less than **8-1/2 inches**, including the nosing, and riser height is not to be more than **9-1/2 inches**.
2. Fabricate ships' ladders, including railings from steel.
3. Fabricate treads and platforms from welded or pressure-locked steel bar grating. Limit openings in gratings to no more than 3/4 inch in least dimension.
4. Fabricate treads and platforms from rolled-steel floor plate.
5. Comply with applicable railing requirements in Section 055213 "Pipe and Tube Railings."

B. Galvanize and prime exterior steel ships' ladders, including treads, railings, brackets, and fasteners.

C. Prime exterior steel ships' ladders, including treads, railings, brackets, and fasteners, with zinc-rich primer.

2.11 METAL PIPE CROSSOVERS

A. Galvanize and prime steel pipe crossovers, including treads, railings, brackets, and fasteners.

B. Prime exterior steel pipe crossovers, including treads, railings, brackets, and fasteners, with zinc-rich primer.

2.12 STRUCTURAL-STEEL DOOR FRAMES

A. Galvanize and prime steel frames.

B. Prime exterior steel frames with zinc-rich primer.

2.13 MISCELLANEOUS STEEL TRIM

A. Galvanize and prime miscellaneous steel trim.

B. Prime exterior miscellaneous steel trim with zinc-rich primer.

2.14 METAL BOLLARDS

A. Metal Bollards : Fabricate metal bollards from Schedule 40 steel pipe.

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1. Where bollards are indicated to receive controls for door operators, provide cutouts for controls and holes for wire.
2. Where bollards are indicated to receive light fixtures, provide cutouts for fixtures and holes for wire.

B. Prime steel bollards with zinc-rich primer.

2.15 PIPE AND DOWNSPOUT GUARDS

A. Galvanize and prime steel pipe guards.

B. Prime steel pipe guards with zinc-rich primer.

2.16 ABRASIVE METAL NOSINGS, TREADS, AND THRESHOLDS

A. Provide anchors for embedding units in concrete, either integral or applied to units, as standard with manufacturer.

B. Drill for mechanical anchors and countersink. Locate holes not more than **4 inches** from ends and not more than **12 inches** o.c., evenly spaced between ends, unless otherwise indicated. Provide closer spacing if recommended in writing by manufacturer.

1. Provide two rows of holes for units more than **5 inches** wide, with two holes aligned at ends and intermediate holes staggered.

2.17 CAST-IRON WHEEL GUARDS

A. Prime cast-iron wheel guards with zinc-rich primer.

2.18 METAL DOWNSPOUT BOOTS

A. Prime cast-iron downspout boots with zinc-rich primer.

2.19 LOOSE BEARING AND LEVELING PLATES

A. Loose Bearing and Leveling Plates : Provide loose bearing and leveling plates for steel items bearing on masonry or concrete construction. Drill plates to receive anchor bolts and for grouting.

B. Galvanize bearing and leveling plates.

C. Prime plates with zinc-rich primer.

2.20 LOOSE STEEL LINTELS

A. Loose Steel Lintels : Fabricate loose steel lintels from steel angles and shapes of size indicated for openings and recesses in masonry walls and partitions at locations indicated. Fabricate in single lengths for each opening unless otherwise indicated. Weld adjoining members together to form a single unit where indicated.

1. Size loose lintels to provide bearing length at each side of openings equal to one-twelfth of clear span, but not less than **8 inches** unless otherwise indicated.

B. Galvanize and prime loose steel lintels located in exterior walls.

C. Prime loose steel lintels located in exterior walls with zinc-rich primer.

2.21 STEEL WELD PLATES AND ANGLES

A. Steel Weld Plates and Angles : Provide steel weld plates and angles not specified in other Sections, for items supported from concrete construction as needed to complete the Work. Provide each unit with no fewer than two integrally welded steel strap anchors for embedding in concrete.

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2.22 GENERAL FINISH REQUIREMENTS

A. Finish metal fabrications after assembly.

B. Finish exposed surfaces to remove tool and die marks and stretch lines, and to blend into surrounding surface.

2.23 STEEL AND IRON FINISHES

A. Galvanizing: Hot-dip galvanize items as indicated to comply with ASTM A153/A153M for steel and iron hardware and with ASTM A123/A123M for other steel and iron products.

1. Do not quench or apply post galvanizing treatments that might interfere with paint adhesion.

B. Preparation for Shop Priming Galvanized Items: After galvanizing, thoroughly clean galvanized surfaces of grease, dirt, oil, flux, and other foreign matter, and treat with metallic phosphate process.

C. Shop prime iron and steel items not indicated to be galvanized unless they are to be embedded in concrete, sprayed-on fireproofing, or masonry, or unless otherwise indicated.

1. Shop prime with universal shop primer primers specified in Section 099113 "Exterior Painting" Section 099123 "Interior Painting" unless zinc-rich primer is indicated.

D. Preparation for Shop Priming: Prepare surfaces to comply with SSPC-SP 3, "Power Tool Cleaning."

1. Exterior Items: SSPC-SP 6/NACE No. 3, "Commercial Blast Cleaning."
2. Items Indicated to Receive Zinc-Rich Primer: SSPC-SP 6/NACE No. 3, "Commercial Blast Cleaning."
3. Items Indicated to Receive Primers Specified in Section 099600 "High-Performance Coatings": SSPC-SP 6/NACE No. 3, "Commercial Blast Cleaning."
4. Other Steel Items: SSPC-SP 3, "Power Tool Cleaning."
5. Galvanized-Steel Items: SSPC-SP 16, "Brush-off Blast Cleaning of Coated and Uncoated Galvanized Steel, Stainless Steels, and Non-Ferrous Metals."

E. Shop Priming: Apply shop primer to comply with SSPC-PA 1, "Paint Application Specification No. 1: Shop, Field, and Maintenance Painting of Steel," for shop painting.

1. Stripe paint corners, crevices, bolts, welds, and sharp edges.

2.24 ALUMINUM FINISHES

A. As-Fabricated Finish: AA-M12.

B. Clear Anodic Finish: AAMA 611, Class I, AA-M12C22A41.

PART 3 - EXECUTION

3.1 INSTALLATION OF METAL FABRICATIONS, GENERAL

A. Cutting, Fitting, and Placement: Perform cutting, drilling, and fitting required for installing metal fabrications. Set metal fabrications accurately in location, alignment, and elevation; with edges and surfaces level, plumb, true, and free of rack; and measured from established lines and levels.

B. Fit exposed connections accurately together to form hairline joints. Weld connections that are not to be left as exposed joints but cannot be shop welded because of shipping size limitations. Do not weld, cut, or abrade surfaces of exterior units that have been hot-dip galvanized after fabrication and are for bolted or screwed field connections.

C. Field Welding: Comply with the following requirements:

1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
2. Obtain fusion without undercut or overlap.

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3. Remove welding flux immediately.
4. At exposed connections, finish exposed welds and surfaces smooth and blended so no roughness shows after finishing and contour of welded surface matches that of adjacent surface.

D. Fastening to In-Place Construction: Provide anchorage devices and fasteners where metal fabrications are required to be fastened to in-place construction. Provide threaded fasteners for use with concrete and masonry inserts, toggle bolts, through bolts, lag screws, wood screws, and other connectors.

E. Provide temporary bracing or anchors in formwork for items that are to be built into concrete, masonry, or similar construction.

F. Corrosion Protection: Coat concealed surfaces of aluminum that come into contact with grout, concrete, masonry, wood, or dissimilar metals with the following:

1. Cast Aluminum: Heavy coat of bituminous paint.
2. Extruded Aluminum: Two coats of clear lacquer.

3.2 INSTALLATION OF METAL LADDERS

A. Secure ladders to adjacent construction with the clip angles attached to the stringer.

B. Install brackets as required to secure ladders welded or bolted to structural steel or built into masonry or concrete.

3.3 INSTALLATION OF METAL SHIPS' LADDERS

A. Secure top and bottom of ships' ladders to construction to comply with manufacturer's written instructions.

3.4 INSTALLATION OF METAL BOLLARDS

A. Fill metal-capped bollards solidly with concrete and allow concrete to cure seven days before installing.

1. Do not fill removable bollards with concrete.

B. Anchor bollards to existing construction with anchor bolts. Provide four **3/4-inch** bolts at each bollard unless otherwise indicated.

1. Embed anchor bolts at least **4 inches** in concrete.

C. Anchor bollards in place with concrete footings. Center and align bollards in holes **3 inches** above bottom of excavation. Place concrete and vibrate or tamp for consolidation. Support and brace bollards in position until concrete has cured.

D. Fill bollards solidly with concrete, mounding top surface to shed water.

1. Do not fill removable bollards with concrete.

3.5 INSTALLATION OF LOOSE BEARING AND LEVELING PLATES

A. Clean concrete and masonry bearing surfaces of bond-reducing materials, and roughen to improve bond to surfaces. Clean bottom surface of plates.

B. Set bearing and leveling plates on wedges, shims, or leveling nuts. After bearing members have been positioned and plumbed, tighten anchor bolts. Do not remove wedges or shims but, if protruding, cut off flush with edge of bearing plate before packing with shrinkage-resistant grout. Pack grout solidly between bearing surfaces and plates to ensure that no voids remain.

3.6 REPAIRS

A. Touchup Painting:

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1. Immediately after erection, clean field welds, bolted connections, and abraded areas. Paint uncoated and abraded areas with same material as used for shop painting to comply with SSPC-PA 1 for touching up shop-painted surfaces.

    a. Apply by brush or spray to provide a minimum **2.0-mil** dry film thickness.

2. Cleaning and touchup painting of field welds, bolted connections, and abraded areas of shop paint are specified in Section 099113 "Exterior Painting."

B. Galvanized Surfaces: Clean field welds, bolted connections, and abraded areas; repair galvanizing to comply with ASTM A780/A780M.

END OF SECTION 05 50 00

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SECTION 05 52 13 - PIPE AND TUBE RAILINGS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Steel railings.

B. Related Requirements:

1. Section 055113 "Metal Pan Stairs" for steel tube railings associated with metal pan stairs.
2. Section 057300 "Decorative Metal Railings" for ornamental railings fabricated from pipes and tubes and guard-infill metals.
3. Section 096900 "Access Flooring" for railings included with access flooring.

1.2 COORDINATION

A. Coordinate selection of shop primers with topcoats to be applied over them. Comply with paint and coating manufacturers' written recommendations to ensure that shop primers and topcoats are compatible with one another.

B. Coordinate installation of anchorages for railings. Furnish setting drawings, templates, and directions for installing anchorages, including sleeves, concrete inserts, anchor bolts, and items with integral anchors, that are to be embedded in concrete or masonry. Deliver such items to Project site in time for installation.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of specified product.

B. Shop Drawings: Include plans, elevations, sections, and attachment details.

C. Samples for Initial Selection: For products involving selection of color, texture, or design , including mechanical finishes.

D. Samples for Verification: For each type of exposed finish required.

1. Sections of each distinctly different linear railing member, including handrails, top rails, posts, and balusters, including finish.
2. Fittings and brackets.
3. Assembled Sample of railing system, made from full-size components, including top rail, post, handrail, and infill. Sample need not be full height.

    a. Show method of connecting members at intersections.

E. Delegated Design Submittals: For railings, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

1.4 INFORMATIONAL SUBMITTALS

A. Welding Certificates: For shop or field welding.

B. Mill Certificates: Signed by manufacturers of stainless steel products, certifying that products furnished comply with requirements.

C. Paint Compatibility Certificates: From manufacturers of topcoats applied over shop primers, certifying that shop primers are compatible with topcoats.

D. Product Test Reports: For tests on railings performed by a qualified testing agency, in accordance with

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ASTM E894 and ASTM E935.

E. Research Reports: For post-installed anchors, from ICC-ES or other qualified testing agency acceptable to authorities having jurisdiction.

F. Qualification Statements: For delegated design professional engineer.

1.5 QUALITY ASSURANCE

A. Welding Qualifications: Qualify procedures and personnel in accordance with the following:

1. AWS D1.1/D1.1M, "Structural Welding Code - Steel."
2. AWS D1.2/D1.2M, "Structural Welding Code - Aluminum."
3. AWS D1.6/D1.6M, "Structural Welding Code - Stainless Steel."

1.6 DELIVERY, STORAGE, AND HANDLING

A. Protect mechanical finishes on exposed surfaces of railings from damage by applying a strippable, temporary protective covering before shipping.

1.7 FIELD CONDITIONS

A. Field Measurements: Verify actual locations of walls and other construction contiguous with railings by field measurements before fabrication.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Delegated Design: Engage a qualified professional engineer, as defined in Section 014000 "Quality Requirements," to design railings, including attachment to building construction.

B. Structural Performance: Railings, including attachment to building construction, withstand the effects of gravity loads and the following loads and stresses within limits and under conditions indicated:

1. Handrails and Top Rails of Guards:

   a. Uniform load of **50 lbf/ ft.** applied in any direction.
   b. Concentrated load of **200 lbf** applied in any direction.
   c. Uniform and concentrated loads need not be assumed to act concurrently.

2. Infill of Guards:

   a. Concentrated load of **50 lbf** applied horizontally on an area of **1 sq. ft.**.
   b. Infill load and other loads need not be assumed to act concurrently.

C. 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 METALS, GENERAL

A. Metal Surfaces, General: Provide materials with smooth surfaces, without seam marks, roller marks, rolled trade names, stains, discolorations, or blemishes.

B. Brackets, Flanges, and Anchors: Cast or formed metal of same type of material and finish as supported rails unless otherwise indicated.

1. Provide type of bracket with flange tapped for concealed anchorage to threaded hanger bolt and that provides **1-1/2-inch** clearance from inside face of handrail to finished wall surface.

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2.3 STEEL RAILINGS

A. Steel Railing:

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. Hollaender Mfg. Co.
   b. Kee Safety, Inc.
   c. Trex Commercial Products, Inc.
   d. TrueNorth Steel
   e. VIVA Railings, LLC
   f. Wagner Companies (The); R&B Wagner, Inc.

2. Source Limitations: Obtain each type of railing from single source from single manufacturer.
3. Tubing: ASTM A500/A500M (cold formed) or ASTM A513/A513M, Type 5.
4. Pipe: ASTM A53/A53M, Type F or Type S, Grade A, Standard Weight (Schedule 40), unless another grade and weight are required by structural loads.

   a. Provide galvanized finish for exterior installations and where indicated.

5. Plates, Shapes, and Bars: ASTM A36/A36M.
6. Cast Iron Fittings: Either gray iron, ASTM A48/A48M, or malleable iron, ASTM A47/A47M, unless otherwise indicated.

2.4 FASTENERS

A. Fastener Materials:

1. Ungalvanized-Steel Railing Components: Plated steel fasteners complying with ASTM F1941/F1941M, Class Fe/Zn 5 for zinc coating.
2. Hot-Dip Galvanized Railing Components: Type 304 stainless steel or hot-dip zinc-coated steel fasteners complying with ASTM A153/A153M or ASTM F2329/F2329M for zinc coating.
3. Aluminum Railing Components: Type 304 stainless steel fasteners.
4. Stainless Steel Railing Components: Type 304 stainless steel fasteners.
5. Finish exposed fasteners to match appearance, including color and texture, of railings.

B. Fasteners for Anchoring Railings to Other Construction: Select fasteners of type, grade, and class required to produce connections suitable for anchoring railings to other types of construction and capable of withstanding design loads.

C. Fasteners for Interconnecting Railing Components:

1. Provide concealed fasteners for interconnecting railing components and for attaching them to other work, unless otherwise indicated.
2. Provide concealed fasteners for interconnecting railing components and for attaching them to other work, unless exposed fasteners are unavoidable or are the standard fastening method for railings indicated.
3. Provide tamper-resistant flat-head machine screws for exposed fasteners unless otherwise indicated.

D. Post-Installed Anchors: Fastener systems with working capacity greater than or equal to the design load, according to an evaluation report acceptable to authorities having jurisdiction.

1. Acceptance Criteria: ICC-ES AC193.
2. Material for Interior Locations: Carbon-steel components zinc-plated to comply with ASTM B633 or ASTM F1941/F1941M, Class Fe/Zn 5, unless otherwise indicated.
3. Material for Exterior Locations and Where Stainless Steel Is Indicated: Alloy Group 1 stainless steel bolts, ASTM F593, and nuts, ASTM F594.

2.5 MISCELLANEOUS MATERIALS

A. Handrail Brackets:

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1. Material: Cast stainless steel.
2. Center of Handrail: 2-1/2 inches from wall.

B. Welding Rods and Bare Electrodes: Select in accordance with AWS specifications for metal alloy welded.

1. For aluminum and stainless steel railings, provide type and alloy as recommended by producer of metal to be welded and as required for color match, strength, and compatibility in fabricated items.

C. Etching Cleaner for Galvanized Metal: Complying with MPI#25.

D. Galvanizing Repair Paint: High-zinc-dust-content paint, complying with SSPC-Paint 20 and compatible with paints specified to be used over it.

E. Shop Primers: Provide primers that comply with Section 099113 "Exterior Painting." , Section 099123 "Interior Painting."

F. Universal Shop Primer: Fast-curing, lead- and chromate-free, universal modified-alkyd primer complying with MPI#79 and compatible with topcoat.

1. Use primer containing pigments that make it easily distinguishable from zinc-rich primer.

G. Epoxy Zinc-Rich Primer: Complying with MPI#20 and compatible with topcoat.

H. Shop Primer for Galvanized Steel: Primer formulated for exterior use over zinc-coated metal and compatible with finish paint systems indicated.

I. Intermediate Coats and Topcoats: Provide products that comply with Section 099113 "Exterior Painting." , Section 099123 "Interior Painting."

J. Epoxy Intermediate Coat: Complying with MPI #77 and compatible with primer and topcoat.

K. Polyurethane Topcoat: Complying with MPI #72 and compatible with undercoat.

L. Bituminous Paint: Cold-applied asphalt emulsion, complying with ASTM D1187/D1187M.

M. Nonshrink, Nonmetallic Grout: Factory-packaged, nonstaining, noncorrosive, nongaseous grout, complying with ASTM C1107/C1107M. Provide grout specifically recommended by manufacturer for interior and exterior applications.

N. Anchoring Cement: Factory-packaged, nonshrink, nonstaining, hydraulic-controlled expansion cement formulation for mixing with water at Project site to create pourable anchoring, patching, and grouting compound.

1. Water-Resistant Product: At exterior locations and where indicated on Drawings, provide formulation that is resistant to erosion from water exposure without needing protection by a sealer or waterproof coating and that is recommended by manufacturer for exterior use.

2.6 FABRICATION

A. General: Fabricate railings to comply with requirements indicated for design, dimensions, member sizes and spacing, details, finish, and anchorage , but not less than that required to support structural loads.

B. Shop assemble railings to greatest extent possible to minimize field splicing and assembly. Disassemble units only as necessary for shipping and handling limitations.

1. Clearly mark units for reassembly and coordinated installation.
2. Use connections that maintain structural value of joined pieces.

C. Cut, drill, and punch metals cleanly and accurately.

1. Remove burrs and ease edges to a radius of approximately **1/32 inch** unless otherwise indicated.
2. Remove sharp or rough areas on exposed surfaces.

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D. Form work true to line and level with accurate angles and surfaces.

E. Fabricate connections that are exposed to weather in a manner that excludes water.

1. Provide weep holes where water may accumulate.
2. Locate weep holes in inconspicuous locations.

F. Cut, reinforce, drill, and tap as indicated to receive finish hardware, screws, and similar items.

G. Connections: Fabricate railings with welded connections unless otherwise indicated.

H. Welded Connections: Cope components at connections to provide close fit, or use fittings designed for this purpose. Weld all around at connections, including at fittings.

1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
2. Obtain fusion without undercut or overlap.
3. Remove flux immediately.
4. At exposed connections, finish exposed welds to comply with NOMMA's "Voluntary Joint Finish Standards" for Finish #2 welds; good appearance, completely sanded joint, some undercutting and pinholes okay.

I. Welded Connections for Aluminum Pipe: Fabricate railings to interconnect members with concealed internal welds that eliminate surface grinding, using manufacturer's standard system of sleeve and socket fittings.

J. Nonwelded Connections: Connect members with concealed mechanical fasteners and fittings. Fabricate members and fittings to produce flush, smooth, rigid, hairline joints.

1. Fabricate splice joints for field connection, using an epoxy structural adhesive, if this is manufacturer's standard splicing method.

K. Directional Changes:

1. Form changes in direction as detailed on Drawings.
2. Form changes in direction by bending or by inserting prefabricated elbow fittings.
3. Form changes in direction by flush bends or by inserting prefabricated flush-elbow fittings.
4. Form changes in direction by radius bends of radius indicated or by inserting prefabricated elbow fittings of radius indicated.
5. Form changes in direction by bending to smallest radius that will not result in distortion of railing member.

L. Bend members in jigs to produce uniform curvature for each configuration required. Maintain cross section of member throughout entire bend without buckling, twisting, cracking, or otherwise deforming exposed surfaces of components.

M. Close exposed ends of hollow railing members with prefabricated cap and end fittings of same metal and finish as railings.

N. Provide wall returns at ends of wall-mounted handrails unless otherwise indicated. Close ends of returns unless clearance between end of rail and wall is **1/4 inch** or less.

O. Brackets, Flanges, Fittings, and Anchors: Provide wall brackets, flanges, miscellaneous fittings, and anchors to interconnect railing members to other work unless otherwise indicated.

1. At brackets and fittings fastened to plaster or gypsum board partitions, provide crush-resistant fillers or other means to transfer loads through wall finishes to structural supports and prevent bracket or fitting rotation and crushing of substrate.

P. Provide inserts and other anchorage devices for connecting railings to concrete or masonry work.

1. Fabricate anchorage devices capable of withstanding loads imposed by railings.
2. Coordinate anchorage devices with supporting structure.

Q. For railing posts set in concrete, provide stainless steel sleeves not less than **6 inches** long with inside dimensions not less than **1/2 inch** greater than outside dimensions of post, with metal plate forming

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bottom closure.

R. For removable railing posts, fabricate slip-fit sockets from stainless steel tube or pipe whose ID is sized for a close fit with posts; limit movement of post without lateral load, measured at top, to not more than one-fortieth of post height.

1. Provide socket covers designed and fabricated to resist being dislodged.
2. Provide chain with eye, snap hook, and staple across gaps formed by removable railing sections at locations indicated. Fabricate from same metal as railings.

S. Toe Boards: Where indicated, provide toe boards at railings around openings and at edge of open-sided floors and platforms. Fabricate to dimensions and details indicated.

2.7 STEEL AND IRON FINISHES

A. Galvanized Railings:

1. Hot-dip galvanize exterior steel railings, including hardware, after fabrication.
2. Comply with ASTM A123/A123M for hot-dip galvanized railings.
3. Comply with ASTM A153/A153M for hot-dip galvanized hardware.
4. Do not quench or apply post-galvanizing treatments that might interfere with paint adhesion.
5. Fill vent and drain holes that are exposed in the finished Work, unless indicated to remain as weep holes, by plugging with zinc solder and filing off smooth.

B. For galvanized railings, provide hot-dip galvanized fittings, brackets, fasteners, sleeves, and other ferrous components.

C. Preparing Galvanized Railings for Shop Priming: After galvanizing, thoroughly clean railings of grease, dirt, oil, flux, and other foreign matter, and treat with etching cleaner and as follows.

1. Comply with SSPC-SP 16.

D. For nongalvanized-steel railings, provide nongalvanized ferrous-metal fittings, brackets, fasteners, and sleeves; however, hot-dip galvanize anchors to be embedded in exterior concrete or masonry.

E. Preparation for Shop Priming: Prepare uncoated ferrous-metal surfaces to comply with SSPC-SP 6/NACE No. 3.

1. Exterior Railings: SSPC-SP 6/NACE No. 3.
2. Railings Indicated To Receive Zinc-Rich Primer: SSPC-SP 6/NACE No. 3.
3. Railings Indicated To Receive Primers Specified in Section 099600 "High-Performance Coatings": SSPC-SP 6/NACE No. 3.
4. Other Railings: SSPC-SP 3.

F. Primer Application: Apply shop primer to prepared surfaces of railings unless otherwise indicated. Comply with requirements in SSPC-PA 1 for shop painting. Primer need not be applied to surfaces to be embedded in concrete or masonry.

1. Shop prime uncoated railings with universal shop primer unless zinc-rich primer is indicated.
2. Do not apply primer to galvanized surfaces.

G. Shop-Painted Finish: Comply with Section 099113 "Exterior Painting."

1. Color: As selected by Architect from manufacturer's full range.

2.8 ALUMINUM FINISHES

A. Appearance of Finished Work: Variations in appearance of abutting or adjacent pieces are acceptable if they are within one-half of the range of approved Samples. Noticeable variations in the same piece are unacceptable. Variations in appearance of other components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

B. Mill Finish: AA-M12, nonspecular as fabricated.

C. Clear Anodic Finish: AAMA 611, AA-M12C22A41.

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D. Color Anodic Finish: AAMA 611, AA-M12C22A42/A44.

1. Color: As selected by Architect from full range of industry colors and color densities.

E. Baked-Enamel or Powder-Coat Finish: AAMA 2603 except with a minimum dry film thickness of **1.5 mils**. Comply with coating manufacturer's written instructions for cleaning, conversion coating, and applying and baking finish.

1. Color and Gloss: As selected by Architect from manufacturer's full range.

F. High-Performance Organic Finish, Two-Coat Polyvinylidene Fluoride (PVDF): Fluoropolymer finish complying with AAMA 2604 and containing not less than 50 percent polyvinylidene fluoride (PVDF) resin by weight in color coat. Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions .

1. Color and Gloss: As selected by Architect from manufacturer's full range.

G. Superior Performance Organic Finish, Three-Coat Polyvinylidene Fluoride (PVDF): Fluoropolymer finish complying with AAMA 2605 and containing not less than 70 percent polyvinylidene fluoride (PVDF) resin by weight in both color coat and clear topcoat. Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions .

1. Color and Gloss: As selected by Architect from manufacturer's full range.

H. Superior Performance Organic Finish, Four-Coat Polyvinylidene Fluoride (PVDF): Fluoropolymer finish complying with AAMA 2605 and containing not less than 70 percent polyvinylidene fluoride (PVDF) resin by weight in both color coat and clear topcoat. Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions .

1. Color and Gloss: As selected by Architect from manufacturer's full range.

I. Single-Coat Superior Performance FEVE Organic Finish: Single-coat fluoroethylene vinyl ether (FEVE) fluoropolymer finish, complying with AAMA 2605. Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions.

1. Color and Gloss: As selected by Architect from manufacturer's full range.

J. Two-Coat Superior Performance FEVE Organic Finish: Two-coat fluoroethylene vinyl ether (FEVE) fluoropolymer finish complying with AAMA 2605. Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions for seacoast and severe environments.

1. Color and Gloss: As selected by Architect from manufacturer's full range.

2.9 STAINLESS STEEL FINISHES

A. Surface Preparation: Remove tool and die marks and stretch lines, or blend into finish.

B. Polished Finishes: Grind and polish surfaces to produce uniform finish, free of cross scratches.

1. Run grain with long dimension of each piece.
2. When polishing is completed, passivate and rinse surfaces.
3. Remove embedded foreign matter and leave surfaces chemically clean.

C. Stainless Steel Pipe and Tubing Finishes:

1. 180-Grit Polished Finish: Uniform, directionally textured finish.
2. 320-Grit Polished Finish: Oil-ground, uniform, fine, directionally textured finish.
3. Polished and Buffed Finish: 320-grit finish followed by buffing to a high luster finish.

D. Stainless Steel Sheet and Plate Finishes:

1. Directional Satin Finish: ASTM A480/A480, No. 4.
2. High-Luster Finish: ASTM A480/A480M, No. 7.
3. Mirror Finish: ASTM A480/A480M, No. 8.

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PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine plaster and gypsum board assemblies, where reinforced to receive anchors, to verify that locations of concealed reinforcements are clearly marked for Installer. Locate reinforcements and mark locations if not already done.

3.2 INSTALLATION OF PIPE AND TUBE RAILINGS, GENERAL

A. Perform cutting, drilling, and fitting required for installing railings.

1. Fit exposed connections together to form tight, hairline joints.
2. Install railings level, plumb, square, true to line; without distortion, warp, or rack.
3. Set railings accurately in location, alignment, and elevation; measured from established lines and levels.
4. Do not weld, cut, or abrade surfaces of railing components that are coated or finished after fabrication and that are intended for field connection by mechanical or other means without further cutting or fitting.
5. Set posts plumb within a tolerance of **1/16 inch in 3 ft.**.
6. Align rails so variations from level for horizontal members and variations from parallel with rake of steps and ramps for sloping members do not exceed **1/4 inch in 12 ft,**.

B. Control of Corrosion: Prevent galvanic action and other forms of corrosion by insulating metals and other materials from direct contact with incompatible materials.

1. Coat concealed surfaces of aluminum that will be in contact with grout, concrete, masonry, wood, or dissimilar metals, with a heavy coat of bituminous paint.

C. Adjust railings before anchoring to ensure matching alignment at abutting joints.

D. Fastening to In-Place Construction: Use anchorage devices and fasteners where necessary for securing railings and for properly transferring loads to in-place construction.

3.3 RAILING CONNECTIONS

A. Nonwelded Connections: Use mechanical or adhesive joints for permanently connecting railing components. Use wood blocks and padding to prevent damage to railing members and fittings. Seal recessed holes of exposed locking screws, using plastic cement filler colored to match finish of railings.

B. Welded Connections: Use fully welded joints for permanently connecting railing components. Comply with requirements for welded connections in "Fabrication" Article, whether welding is performed in the shop or in the field.

C. Expansion Joints: Install expansion joints at locations indicated but not farther apart than required to accommodate thermal movement. Provide slip-joint internal sleeve, extending **2 inches** beyond joint on either side; fasten internal sleeve securely to one side; and locate joint within **6 inches** of post.

3.4 ANCHORING POSTS

A. Use stainless steel pipe sleeves preset and anchored into concrete for installing posts. After posts are inserted into sleeves, fill annular space between post and sleeve with nonshrink, nonmetallic grout or anchoring cement, mixed and placed to comply with anchoring material manufacturer's written instructions.

B. Form or core-drill holes not less than **5 inches** deep and **3/4 inch** larger than OD of post for installing posts in concrete. Clean holes of loose material, insert posts, and fill annular space between post and concrete with nonshrink, nonmetallic grout or anchoring cement, mixed and placed to comply with anchoring material manufacturer's written instructions.

C. Cover anchorage joint with flange of same metal as post, welded to post after placing anchoring

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material.

D. Leave anchorage joint exposed with anchoring material flush with adjacent surface.

E. Anchor posts to metal surfaces with flanges, angle type, or floor type, as required by conditions, connected to posts and to metal supporting members as follows:

1. Steel Railings: Weld flanges to post and bolt to metal supporting surfaces.
2. Aluminum Railings: Attach posts as indicated on Drawings, using fittings designed and engineered for this purpose.
3. Stainless Steel Railings: Weld flanges to post and bolt to supporting surfaces.

F. Install removable railing sections, where indicated, in slip-fit stainless steel sockets cast in concrete.

3.5 ATTACHING RAILINGS

A. Anchor railing ends to concrete and masonry with sleeves concealed within railing ends and anchored to wall construction with anchors and bolts.

B. Anchor railing ends to metal surfaces with flanges bolted to metal surfaces and welded to railing ends or connected to railing ends, using nonwelded connections.

C. Attach handrails to walls with wall brackets , except where end flanges are used. Provide brackets with 1-1/2-inch clearance from inside face of handrail and finished wall surface.

1. Use type of bracket with flange tapped for concealed anchorage to threaded hanger bolt.
2. Locate brackets as indicated on Drawings or, if not indicated, at spacing required to support structural loads.

D. Secure wall brackets and railing end flanges to building construction.

1. For concrete and solid masonry anchorage, use drilled-in expansion shields and hanger or lag bolts.
2. For hollow masonry anchorage, use toggle bolts.
3. For wood stud partitions, use hanger or lag bolts set into studs or wood backing between studs. Coordinate with carpentry work to locate backing members.
4. For steel-framed partitions, use hanger or lag bolts set into wood backing between studs. Coordinate with stud installation to locate backing members.
5. For steel-framed partitions, fasten brackets directly to steel framing or concealed steel reinforcements, using self-tapping screws of size and type required to support structural loads.
6. For steel-framed partitions, use toggle bolts installed through flanges of steel framing or through concealed steel reinforcements.

E. Install railing gates level, plumb, and secure for full opening without interference.

1. Attach hardware using tamper-resistant or concealed means.
2. Adjust hardware for smooth operation.

3.6 REPAIR

A. Touchup Painting:

1. Immediately after erection, clean field welds, bolted connections, and abraded areas of shop paint, and paint exposed areas with the same material used for shop painting to comply with SSPC-PA 1 for touching up shop-painted surfaces.

   a. Apply by brush or spray to provide a minimum **2.0-mil** dry film thickness.

2. Cleaning and touchup painting of field welds, bolted connections, and abraded areas of shop paint are specified in Section 099113 "Exterior Painting." , Section 099123 "Interior Painting."

3.7 CLEANING

A. Clean aluminum and stainless steel by washing thoroughly with clean water and soap and rinsing with

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clean water.

B. Galvanized Surfaces: Clean field welds, bolted connections, and abraded areas, and repair galvanizing to comply with ASTM A780/A780M.

3.8 PROTECTION

A. Protect finishes of railings from damage during construction period with temporary protective coverings approved by railing manufacturer. Remove protective coverings at time of Substantial Completion.

B. Restore finishes damaged during installation and construction period, so no evidence remains of correction work. Return items that cannot be refinished in the field to the shop; make required alterations and refinish entire unit, or provide new units.

END OF SECTION 05 52 13

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SECTION 05 73 00 - DECORATIVE METAL RAILINGS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Steel and iron decorative railing system.

B. Related Requirements:

1. Section 055213 "Pipe and Tube Railings" for nonornamental railings fabricated from pipes and tubes.
2. Section 061000 "Rough Carpentry" for wood blocking for anchoring railings.

1.2 COORDINATION

A. Coordinate selection of shop primers with topcoats to be applied over them. Comply with paint and coating manufacturers' written instructions to ensure that shop primers and topcoats are compatible.

B. Coordinate installation of anchorages for railings. Furnish setting drawings, templates, and directions for installing anchorages, including sleeves, concrete inserts, anchor bolts, and items with integral anchors, that are to be embedded in concrete or masonry. Deliver items to Project site in time for installation.

1.3 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of specified product.

1. Include manufacturer's product lines of decorative metal railings assembled from standard components.
2. Include all railing system components and finishes.

B. Shop Drawings: Include plans, elevations, sections, and attachment details.

1. Illuminated Rails: Include wiring diagrams and roughing-in details.

C. Samples for Initial Selection: For products involving selection of color, texture, or design , including mechanical finishes.

D. Samples for Verification: For each type of exposed finish required.

1. Sections of each distinctly different linear railing member, including handrails, top rails, posts, and balusters
2. Illuminated railings.
3. Fittings, end caps, and brackets.
4. Welded connections.
5. Brazed connections.
6. Cable and cable hardware and connections.
7. Assembled Sample of railing system, made from full-size components, including top rail, post, handrail, and guard infill. Sample need not be full height.

    a. Show method of connecting and finishing members at intersections.

E. Delegated Design Submittals: For railings, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

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1.5 INFORMATIONAL SUBMITTALS

A. Mill Certificates: Signed by manufacturers of stainless steel products, certifying that products furnished comply with requirements.

B. Welding Certificates: For structural welding of steel.

C. Paint Compatibility Certificates: From manufacturers of topcoats applied over shop primers, certifying that shop primers are compatible with topcoats.

D. Product Test Reports: For tests on railings performed by a qualified testing agency, in accordance with ASTM E894 and ASTM E935.

E. Research Reports: For post-installed anchors, from ICC-ES or other qualified testing agency acceptable to authorities having jurisdiction.

F. Preconstruction Test Reports: For testing on laboratory mockups of railings.

G. Field Quality Control Reports: For specified tests and inspections.

H. Qualification Statements: For testing agency.

I. Delegated Design Professional Qualifications: For railings, including attachment to building construction.

1.6 QUALITY ASSURANCE

A. Testing Agency Qualifications: An independent agency qualified to perform specified field tests and who is acceptable to authorities having jurisdiction.

B. Delegated Design Professional Qualifications: A professional engineer who is legally qualified to practice in state where Project is located and who is experienced in providing engineering services of the type indicated.

C. Welding Qualifications: Qualify procedures and personnel in accordance with the following welding codes:

1. AWS D1.1/D1.1M.
2. AWS D1.2/D1.2M.
3. AWS D1.6/D1.6M.

1.7 MOCKUPS

A. Build mockups to verify selections made under Sample submittals, to demonstrate aesthetic effects, and to set quality standards for fabrication and installation.

1. Build mockups as indicated on Drawings.
2. Build mockups for each form and finish of railing, consisting of two posts, top rail, infill area, and anchorage system components that are full height and are not less than **24 inches** in length.
3. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Owner specifically approves such deviations by Change Order.
4. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.8 DELIVERY, STORAGE, AND HANDLING

A. Protect mechanical finishes on exposed surfaces of railings from damage by applying a strippable, temporary protective covering before shipping.

1.9 FIELD CONDITIONS

A. Field Measurements: Verify actual locations of walls and other construction contiguous with railings by field measurements before fabrication.

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PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Delegated Design: Engage a qualified professional engineer, as defined in Section 014000 "Quality Requirements," to design railings, including attachment to building construction.

B. Structural Performance: Railings, including attachment to building construction, are to withstand the effects of gravity loads and the following loads and stresses within limits and under conditions indicated:

1. Handrails and Top Rails of Guards:

   a. Uniform load of **50 lbf/ft.** applied in any direction.
   b. Concentrated load of **200 lbf** applied in any direction.
   c. Uniform and concentrated loads need not be assumed to act concurrently.

2. Infill of Guards:

   a. Concentrated load of **50 lbf** applied horizontally on an area of **1 sq. ft.**.
   b. Infill load and other loads need not be assumed to act concurrently.

C. Thermal Movements: Allow for thermal movements from ambient and surface temperature changes acting on exterior railings by preventing buckling, opening of joints, overstressing of components, failure of connections, and other detrimental effects.

1. Temperature Change: **120 deg F**, ambient; **180 deg F**, material surfaces.

2.2 METALS, GENERAL

A. Metal Surfaces, General: Provide materials with smooth surfaces, without seam marks, roller marks, rolled trade names, stains, discolorations, or blemishes.

B. Recycled Content of Steel Products: Postconsumer recycled content plus one-half of preconsumer recycled content not less than 25 percent.

C. Brackets, Flanges, and Anchors: Same metal and finish as supported rails unless otherwise indicated.

2.3 ALUMINUM DECORATIVE RAILING SYSTEM

A. Castings: ASTM B26/B26M, Alloy A356.0-T6.

B. Fasteners:

1. Aluminum Railing Components: Type 304 stainless steel fasteners.
2. Dissimilar Metal Railing Components: Type 304 stainless steel fasteners.
3. Finish exposed fasteners to match appearance, including color and texture, of railings.

2.4 STEEL AND IRON DECORATIVE RAILING SYSTEM

A. Steel and Iron Decorative Railing:

1. Source Limitations: Obtain steel decorative railing components from single source from single manufacturer.
2. Tubing: ASTM A500/A500M (cold formed) or ASTM A513/A513M, Type 5.
3. Bars: Hot-rolled, carbon steel complying with ASTM A29/A29M, Grade 1010.
4. Plates, Shapes, and Bars: ASTM A36/A36M.
5. Cast Iron: Either gray iron, ASTM A48/A48M, or malleable iron, ASTM A47/A47M, unless otherwise indicated.

B. Fasteners:

1. Ungalvanized-Steel Railing Components: Plated-steel fasteners complying with ASTM F1941/F1941M, Class Fe/Zn 5 for electrodeposited zinc coating where concealed; Type 304

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stainless steel fasteners where exposed.
2. Hot-Dip Galvanized-Steel Railing Components: Type 304 stainless steel or hot-dip zinc-coated steel fasteners complying with ASTM A153/A153M or ASTM F2329/F2329M for zinc coating.
3. Dissimilar Metal Railing Components: Type 304 stainless steel fasteners.
4. Finish exposed fasteners to match appearance, including color and texture, of railings.

2.5 FASTENERS, GENERAL

A. Fasteners for Anchoring to Other Construction: Select fasteners of type, grade, and class required to produce connections suitable for anchoring railings to other types of construction and capable of withstanding design loads.

B. Provide concealed fasteners for interconnecting railing components and for attaching railings to other work unless exposed fasteners are the standard fastening method for railings indicated.

1. Provide tamper-resistant flat-head machine screws for exposed fasteners unless otherwise indicated.

C. Post-Installed Anchors: Fastener systems with working capacity greater than or equal to the design load, in accordance with an evaluation report acceptable to authorities having jurisdiction, based on ICC-ES AC193 or ICC-ES AC308.

1. Material for Interior Locations: Carbon-steel components zinc plated to comply with ASTM B633 or ASTM F1941/F1941M, Class Fe/Zn 5, unless otherwise indicated.
2. Material for Exterior Locations and Where Stainless Steel Is Indicated: Alloy Group 1 stainless steel bolts, ASTM F593 and nuts, ASTM F594.

2.6 MISCELLANEOUS MATERIALS

A. Handrail Brackets: Cast stainless steel, center of handrail 2-1/2 inches from wall.

1. Provide cast-metal brackets with flange tapped for concealed anchorage to threaded hanger bolt.
2. Provide either formed- or cast-metal brackets with predrilled hole for exposed bolt anchorage.
3. Provide extruded-aluminum brackets with interlocking pieces that conceal anchorage. Locate set screws on bottom of bracket.
4. Provide formed-steel brackets with predrilled hole for bolted anchorage and with snap-on cover that matches rail finish and conceals bracket base and bolt head.

B. Welding Rods and Bare Electrodes: Select according to AWS specifications for metal alloy welded.

1. For aluminum and stainless steel railings, provide type and alloy as recommended by producer of metal to be welded and as required for color match, strength, and compatibility in fabricated items.

C. Etching Cleaner for Galvanized Metal: Compatible with coating system specified.

D. Galvanizing Repair Paint: High-zinc-dust-content paint compatible with coating system specified.

E. Shop Primers: Provide primers that comply with Section 099113 "Exterior Painting." , Section 099123 "Interior Painting."

1. Use primer containing pigments that make it easily distinguishable from zinc-rich primer.

F. Epoxy Zinc-Rich Primer: Compatible with topcoat.

G. Shop Primer for Galvanized Steel: Water-based galvanized metal primer.

H. Intermediate Coats and Topcoats: Provide products that comply with Section 099113 "Exterior Painting." , Section 099123 "Interior Painting."

I. Epoxy Intermediate Coat: Compatible with primer and topcoat.

J. Polyurethane Topcoat: Compatible with undercoat.

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K. Bituminous Paint: Cold-applied asphalt emulsion complying with ASTM D1187/D1187M.

L. Nonshrink, Nonmetallic Grout: Factory-packaged, nonstaining, noncorrosive, nongaseous grout complying with ASTM C1107/C1107M. Provide grout specifically recommended by manufacturer for interior and exterior applications.

M. Anchoring Cement: Factory-packaged, nonshrink, nonstaining, hydraulic-controlled expansion cement formulation for mixing with water at Project site to create pourable anchoring, patching, and grouting compound.

1. Water-Resistant Product: At exterior locations and where indicated on Drawings, provide formulation that is resistant to erosion from water exposure without needing protection by a sealer or waterproof coating and that is recommended by manufacturer for exterior use.

2.7 FABRICATION

A. Fabricate railings to comply with requirements indicated for design, dimensions, member sizes and spacing, details, finish, and anchorage , but not less than that required to support structural loads.

B. Shop assemble railings to greatest extent possible to minimize field splicing and assembly. Disassemble units only as necessary for shipping and handling limitations.

1. Clearly mark units for reassembly and coordinated installation.
2. Use connections that maintain structural value of joined pieces.

C. Cut, drill, and punch metals cleanly and accurately.

1. Remove burrs and ease edges to a radius of approximately **1/32 inch** unless otherwise indicated.
2. Remove sharp or rough areas on exposed surfaces.

D. Form work true to line and level with accurate angles and surfaces.

E. Fabricate connections that will be exposed to weather in a manner to exclude water.

1. Provide weep holes where water may accumulate.
2. Locate weep holes in inconspicuous locations.

F. Cut, reinforce, drill, and tap as indicated to receive finish hardware, screws, and similar items.

G. Connections: Fabricate railings with welded or mechanical connections unless otherwise indicated.

H. Welded Connections: Cope components at connections to provide close fit, or use fittings designed for this purpose. Weld all around at connections, including at fittings.

1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
2. Obtain fusion without undercut or overlap.
3. Remove flux immediately.
4. At exposed connections, finish exposed welds to comply with NOMMA's "Voluntary Joint Finish Standards" for Finish #1 welds; ornamental quality with no evidence of a welded joint.

I. Welded Connections for Aluminum Pipe: Fabricate railings to interconnect members with concealed internal welds that eliminate surface grinding, using manufacturer's standard system of sleeve and socket fittings.

J. Brazed Connections: Connect copper and copper-alloy railings by brazing. Cope components at connections to provide close fit, or use fittings designed for this purpose. Braze corners and seams continuously.

1. Use materials and methods that match color of base metal, minimize distortion, and develop maximum strength and corrosion resistance.
2. Remove flux immediately.
3. At exposed connections, finish exposed surfaces smooth and blended, so no roughness shows after finishing and brazed surface matches contours of adjoining surfaces.

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K. Mechanical Connections: Connect members with concealed mechanical fasteners and fittings.

1. Fabricate members and fittings to produce flush, smooth, rigid, hairline joints.
2. Fabricate splice joints for field connection using an epoxy structural adhesive if this is manufacturer's standard splicing method.

L. Directional Changes:

1. Form changes in direction by bending or by inserting prefabricated elbow fittings.
2. Form changes in direction by bending to smallest radius that will not result in distortion of railing member.

M. Bend members in jigs to produce uniform curvature for each configuration required. Maintain cross section of member throughout entire bend without buckling, twisting, cracking, or otherwise deforming exposed surfaces of components.

N. Close exposed ends of hollow railing members with prefabricated cap and end fittings of same metal and finish as railings.

O. Provide wall returns at ends of wall-mounted handrails unless otherwise indicated. Close ends of returns, unless clearance between end of rail and wall is **1/4 inch** or less.

P. Brackets, Flanges, Fittings, and Anchors: Provide wall brackets, flanges, handrail brackets, miscellaneous fittings, and anchors to interconnect railing members to other Work unless otherwise indicated.

1. At brackets and fittings fastened to plaster or gypsum board partitions, provide crush-resistant fillers or other means to transfer loads through wall finishes to structural supports and to prevent bracket or fitting rotation and crushing of substrate.

Q. Provide inserts and other anchorage devices for connecting railings to concrete or masonry Work.

1. Fabricate anchorage devices capable of withstanding loads imposed by railings.
2. Coordinate anchorage devices with supporting structure.

R. For railing posts set in concrete, provide stainless steel sleeves not less than **6 inches** long with inside dimensions not less than **1/2 inch** greater than outside dimensions of post, with metal plate forming bottom closure.

S. For removable railing posts, fabricate slip-fit sockets from stainless steel tube or pipe whose ID is sized for a close fit with posts; limit movement of post without lateral load, measured at top, to not more than one-fortieth of post height.

1. Provide socket covers designed and fabricated to resist being dislodged.
2. Provide chain with eye, snap hook, and staple across gaps formed by removable railing sections at locations indicated. Fabricate from same metal as railings.

T. Stainless Steel Cable Guard Infill: Fabricate cable guard infill assemblies in the shop to field-measured dimensions with fittings machine swaged.

1. Minimize amount of turnbuckle take-up used for dimensional adjustment, so maximum amount is available for tensioning cable.
2. Tag cable assemblies and fittings to identify installation locations and orientations for coordinated installation.

U. Toe Boards: Where indicated on Drawings, provide toe boards at railings around openings and at edge of open-sided floors and platforms. Fabricate to dimensions and details indicated.

2.8 GENERAL FINISH REQUIREMENTS

A. Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" recommendations for applying and designating finishes.

B. Protect mechanical finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipment.

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C. Appearance of Finished Work: Noticeable variations in same piece are unacceptable. Variations in appearance of abutting or adjacent pieces are acceptable if they are within one-half of the range of approved Samples. Variations in appearance of other components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

D. Provide exposed fasteners with finish matching appearance, including color and texture, of railings.

2.9 ALUMINUM FINISHES

A. Mechanical Finish: AA-M3x; sand top rails, handrails, and intermediate rails in one direction only, parallel to length of railing, with 120- and 320-grit abrasive. After installation, polish railings with No. 0 steel wool immersed in paste wax, then rub to a luster with a soft dry cloth.

B. Clear Anodic Finish: AAMA 611, AA-M12C22A41, Class I, 0.018 mm or thicker.

C. Color Anodic Finish: AAMA 611, AA-M12C22A42/A44, Class I, 0.018 mm or thicker.

1. Color: As selected by Architect from full range of industry colors and color densities.

D. Baked-Enamel or Powder-Coat Finish: AAMA 2603 except with a minimum dry film thickness of **1.5 mils**. Comply with coating manufacturer's written instructions for cleaning, conversion coating, and applying and baking finish.

1. Color and Gloss: As selected by Architect from manufacturer's full range.

E. Siliconized Polyester Finish: Epoxy primer and silicone-modified, polyester-enamel topcoat; with a dry film thickness of not less than **0.2 mil** for primer and **0.8 mil** for topcoat.

1. Color and Gloss: As selected by Architect from manufacturer's full range.

F. High-Performance Organic Finish, Two-Coat Polyvinylidene Fluoride (PVDF): Fluoropolymer finish complying with AAMA 2604 and containing not less than 50 percent polyvinylidene fluoride (PVDF) resin by weight in color coat. Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions .

1. Color and Gloss: As indicated by manufacturer's designations.

G. Superior-Performing Organic Finish, Three-Coat (Polyvinylidene Fluoride (PVDF): Fluoropolymer finish complying with AAMA 2605 and containing not less than 70 percent polyvinylidene fluoride PVDF resin by weight in both color coat and clear topcoat. Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions .

1. Color and Gloss: As selected by Architect from manufacturer's full range.

H. Superior-Performing Organic Finish, Four-Coat Polyvinylidene Fluoride (PVDF): Fluoropolymer finish complying with AAMA 2605 and containing not less than 70 percent polyvinylidene fluoride (PVDF) resin by weight in both color coat and clear topcoat. Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions .

1. Color and Gloss: As selected by Architect from manufacturer's full range.

I. Superior-Performing Organic Finish, Single-Coat FEVE: Fluoropolymer finish complying with AAMA 2605, containing 100 percent fluorinated ethylene vinyl ether (FEVE) resin in color coat. Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions.

1. Color and Gloss: As selected by Architect from manufacturer's full range.

J. Superior-Performing Organic Finish, Two-Coat FEVE: Fluoropolymer finish complying with AAMA 2605, containing 100 percent fluorinated ethylene vinyl ether (FEVE) resin in color coat. Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions for seacoast and severe environments.

1. Color and Gloss: As selected by Architect from manufacturer's full range.

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2.10 STAINLESS STEEL FINISHES

A. Surface Preparation: Remove tool and die marks and stretch lines, or blend into finish.

B. Polished Finishes: Grind and polish surfaces to produce uniform finish, free of cross scratches.

1. Run grain of directional finishes with long dimension of each piece.
2. When polishing is completed, passivate and rinse surfaces.
3. Remove embedded foreign matter and leave surfaces chemically clean.

C. Stainless Steel Tubing Finishes:

1. 180-Grit Polished Finish: Uniform, directionally textured finish.
2. 320-Grit Polished Finish: Oil-ground, uniform, fine, directionally textured finish.
3. Polished and Buffed Finish: 320-grit finish followed by buffing to a high luster finish.

D. Stainless Steel Sheet and Plate Finishes:

1. Directional Satin Finish: ASTM A480/A480M, No. 4.
2. High-Luster Finish: ASTM A480/A480M, No. 7.
3. Mirror Finish: ASTM A480/A480M, No. 8.

2.11 STEEL AND IRON FINISHES

A. Galvanized Railings:

1. Hot-dip galvanize exterior steel and iron railings, including hardware, after fabrication.
2. Hot-dip galvanize indicated steel and iron railings, including hardware, after fabrication.
3. Comply with ASTM A123/A123M for hot-dip galvanized railings.
4. Comply with ASTM A153/A153M for hot-dip galvanized hardware.
5. Do not quench or apply post-galvanizing treatments that might interfere with paint adhesion.
6. Fill vent and drain holes that are exposed in the finished Work, unless indicated to remain as weep holes, by plugging with zinc solder and filing off smooth.

B. For galvanized railings, provide hot-dip galvanized fittings, brackets, fasteners, sleeves, and other ferrous components.

C. Preparing Galvanized Railings for Shop Priming: After galvanizing, thoroughly clean railings of grease, dirt, oil, flux, and other foreign matter, and treat with etching cleaner and as follows:

1. Comply with SSPC-SP 16.

D. For nongalvanized-steel railings, provide nongalvanized ferrous-metal fittings, brackets, fasteners, and sleeves; however, hot-dip galvanize anchors to be embedded in exterior concrete or masonry.

E. Preparation for Shop Priming: Prepare uncoated ferrous-metal surfaces to comply with SSPC-SP 6/NACE No. 3.

1. Exterior Railings: SSPC-SP 6/NACE No. 3.
2. Railings Indicated To Receive Zinc-Rich Primer: SSPC-SP 6/NACE No. 3.
3. Railings Indicated To Receive Primers Specified in Section 099600 "High-Performance Coatings": SSPC-SP 6/NACE No. 3.
4. Other Railings: SSPC-SP 7/NACE No. 4.

F. Primer Application: Apply shop primer to prepared surfaces of railings unless otherwise indicated. Comply with requirements in SSPC-PA 1 for shop painting. Primer need not be applied to surfaces to be embedded in concrete or masonry.

1. Shop prime uncoated railings with primers specified in Section 099113 "Exterior Painting" , primers specified in Section 099123 "Interior Painting" unless zinc-rich primer is unless zinc-rich primer is indicated.
2. Do not apply primer to galvanized surfaces.

G. Shop-Painted Finish: Comply with Section 099113 "Exterior Painting."

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1. Color: As selected by Architect from manufacturer's full range.

H. High-Performance Coating: Apply epoxy intermediate and polyurethane topcoats to prime-coated surfaces. Comply with coating manufacturer's written instructions and with requirements in SSPC-PA 1 for shop painting. Apply at spreading rates recommended by coating manufacturer.

1. Color: As selected by Architect from manufacturer's full range.

I. Powder-Coat Finish for Uncoated Ferrous Metal: Prepare, treat, and coat nongalvanized ferrous metal to comply with resin manufacturer's written instructions and as follows:

1. Prepare uncoated ferrous-metal surfaces to comply with SSPC-SP 6/NACE No. 3.
2. Treat prepared metal with iron-phosphate pretreatment, rinse, and seal surfaces.
3. Apply thermosetting polyester or acrylic urethane powder coating with cured-film thickness of not less than **1.5 mils**.
4. Color: As selected by Architect from manufacturer's full range.

J. Powder-Coat Finish for Galvanized Metal: Prepare, treat, and coat galvanized metal to comply with resin manufacturer's written instructions and as follows:

1. Prepare galvanized metal by thoroughly removing grease, dirt, oil, flux, and other foreign matter.
2. Treat prepared metal with zinc-phosphate pretreatment, rinse, and seal surfaces.
3. Apply thermosetting polyester or acrylic urethane powder coating with cured-film thickness of not less than **1.5 mils**.
4. Color: As selected by Architect from manufacturer's full range.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine plaster and gypsum board assemblies, where reinforced to receive anchors, to verify that locations of concealed reinforcements have been clearly marked for Installer. Locate reinforcements and mark locations if not already done.

3.2 INSTALLATION OF DECORATIVE METAL RAILINGS , GENERAL

A. Perform cutting, drilling, and fitting required for installing railings.

1. Fit exposed connections together to form tight, hairline joints.
2. Install railings level, plumb, square, true to line; without distortion, warp, or rack.
3. Set railings accurately in location, alignment, and elevation; measured from established lines and levels.
4. Do not weld, cut, or abrade surfaces of railing components that have been coated or finished after fabrication and that are intended for field connection by mechanical or other means without further cutting or fitting.
5. Set posts plumb within a tolerance of **1/16 inch in 3 feet**.
6. Align rails so variations from level for horizontal members and variations from parallel with rake of steps and ramps for sloping members do not exceed **1/4 inch in 12 feet**.

B. Control of Corrosion: Prevent galvanic action and other forms of corrosion by insulating metals and other materials from direct contact with incompatible materials.

1. Coat concealed surfaces of aluminum that will be in contact with grout, concrete, masonry, wood, or dissimilar metals, with a heavy coat of bituminous paint.

C. Adjust railings before anchoring to ensure matching alignment at abutting joints.

D. Fastening to In-Place Construction: Use anchorage devices and fasteners where necessary for securing railings and for properly transferring loads to in-place construction.

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3.3 RAILING CONNECTIONS

A. Nonwelded Connections: Use mechanical or adhesive joints for permanently connecting railing components. Use wood blocks and padding to prevent damage to railing members and fittings. Seal recessed holes of exposed locking screws, using plastic cement filler colored to match finish of railings.

B. Welded Connections: Use fully welded joints for permanently connecting railing components. Comply with requirements for welded connections in "Fabrication" Article, whether welding is performed in the shop or in the field.

C. Expansion Joints: Install expansion joints at locations indicated but not farther apart than required to accommodate thermal movement. Provide slip-joint internal sleeve, extending **2 inches** beyond joint on either side; fasten internal sleeve securely to one side; and locate joint within **6 inches** of post.

3.4 ANCHORING POSTS

A. Use stainless steel pipe sleeves preset and anchored into concrete for installing posts. After posts have been inserted into sleeves, fill annular space between post and sleeve with nonshrink, nonmetallic grout or anchoring cement, mixed and placed to comply with anchoring material manufacturer's written instructions.

B. Form or core-drill holes not less than **5 inches** deep and **3/4 inch** larger than OD of post for installing posts in concrete. Clean holes of loose material, insert posts, and fill annular space between post and concrete with nonshrink, nonmetallic grout or anchoring cement, mixed and placed to comply with anchoring material manufacturer's written instructions.

C. Cover anchorage joint with flange of same metal as post, welded to post after placing anchoring material.

D. Leave anchorage joint exposed with anchoring material flush with adjacent surface.

E. Anchor posts to metal surfaces with flanges, angle type, or floor type as required by conditions, connected to posts and to metal supporting members as follows:

1. Steel and Iron Decorative Railings: Weld flanges to posts and bolt to metal-supporting surfaces.

F. Install removable railing sections, where indicated, in slip-fit metal sockets cast in concrete.

3.5 ATTACHING RAILINGS

A. Anchor railing ends to concrete and masonry with brackets on underside of rails connected to railing ends and anchored to wall construction with anchors and bolts.

B. Anchor railing ends to metal surfaces with flanges bolted to metal surfaces and welded to railing ends or connected to railing ends, using nonwelded connections.

C. Attach handrails to walls with wall brackets , except where end flanges are used. Provide brackets with 1-1/2-inch clearance from inside face of handrail and finished wall surface.

1. Use type of bracket with flange tapped for concealed anchorage to threaded hanger bolt.
2. Locate brackets as indicated on Drawings or, if not indicated, at spacing required to support structural loads.

D. Secure wall brackets and railing end flanges to building construction.

1. For concrete and solid masonry anchorage, use drilled-in expansion shields and hanger or lag bolts.
2. For hollow masonry anchorage, use toggle bolts.
3. For wood stud partitions, use hanger or lag bolts set into studs or wood backing between studs. Coordinate with carpentry work to locate backing members.
4. For steel-framed partitions, use hanger or lag bolts set into wood backing between studs. Coordinate with stud installation to locate backing members.
5. For steel-framed partitions, fasten brackets directly to steel framing or concealed steel

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reinforcements using self-tapping screws of size and type required to support structural loads.

6. For steel-framed partitions, fasten brackets with toggle bolts installed through flanges of steel framing or through concealed steel reinforcements.

3.6 REPAIR

A. Touchup Painting:

1. Immediately after erection, clean field welds, bolted connections, and abraded areas of shop paint, and paint exposed areas with the same material used for shop painting to comply with SSPC-PA 1 for touching up shop-painted surfaces.

   a. Apply by brush or spray to provide a minimum **2.0-mil** dry film thickness.

2. Cleaning and touchup painting of field welds, bolted connections, and abraded areas of shop paint are specified in Section 099113 "Exterior Painting." , Section 099123 "Interior Painting."

3.7 FIELD QUALITY CONTROL

A. Testing Agency: Owner will engage a qualified testing agency to perform tests and inspections. Payment for these services will be made by Owner.

B. Extent and Testing Methodology: Testing agency will randomly select completed railing assemblies for testing that are representative of different railing designs and conditions in the completed Work. Test railings in accordance with ASTM E894 and ASTM E935 for compliance with performance requirements.

C. Remove and replace railings where test results indicate that they do not comply with specified requirements unless they can be repaired in a manner satisfactory to Architect and comply with specified requirements.

D. Perform additional testing and inspecting, at Contractor's expense, to determine compliance of replaced or additional work with specified requirements.

E. Prepare test and inspection reports.

3.8 CLEANING

A. Clean by wiping with a damp cloth and then wiping dry.

B. Galvanized Railings: Clean field welds, bolted connections, and abraded areas and repair galvanizing to comply with ASTM A780/A780M.

3.9 PROTECTION

A. Protect finishes of railings from damage during construction period with temporary protective coverings approved by railing manufacturer. Remove protective coverings at time of Substantial Completion.

B. Restore finishes damaged during installation and construction period, so no evidence remains of correction work. Return items that cannot be refinished in the field to the shop; make required alterations and refinish entire unit, or provide new units.

END OF SECTION 05 73 00

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SECTION 06 10 00 - ROUGH CARPENTRY

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Wood products.
2. Wood-preservative-treated lumber.
3. Fire-retardant-treated lumber.
4. Dimension lumber framing.
5. Miscellaneous lumber.
6. Plywood backing panels.

B. Related Requirements:

1. Section 061600 "Sheathing" for sheathing, subflooring, and underlayment.
2. Section 061753 "Shop-Fabricated Wood Trusses" for wood trusses made from dimension lumber.

1.2 DEFINITIONS

A. Boards or Strips: Lumber of less than **2 inches nominal** size in least dimension.

B. Dimension Lumber: Lumber of **2 inches nominal** size or greater but less than **5 inches nominal** size in least dimension.

C. Exposed Framing: Framing not concealed by other construction.

D. SBX: An inorganic boron used to prevent termites and fungal decay.

E. Lumber grading agencies, and abbreviations used to reference them, include the following:

1. NeLMA: Northeastern Lumber Manufacturers' Association.
2. NLGA: National Lumber Grades Authority.
3. RIS: Redwood Inspection Service.
4. SPIB: The Southern Pine Inspection Bureau.
5. WCLIB: West Coast Lumber Inspection Bureau.
6. WWPA: Western Wood Products Association.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of specified product. Indicate component materials and dimensions and include construction and application details.

1. Include data for wood-preservative treatment from chemical treatment manufacturer and certification by treating plant that treated materials comply with requirements. Indicate type of preservative used and net amount of preservative retained.
2. Include data for fire-retardant treatment from chemical treatment manufacturer and certification by treating plant that treated materials comply with requirements. Include physical properties of treated materials based on testing by a qualified independent testing agency.
3. For fire-retardant treatments, include physical properties of treated lumber both before and after exposure to elevated temperatures, based on testing by a qualified independent testing agency in accordance with ASTM D5664.
4. For products receiving a waterborne treatment, include statement that moisture content of treated materials was reduced to levels specified before shipment to Project site.

1.4 INFORMATIONAL SUBMITTALS

A. Material Certificates:

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1. For dimension lumber specified to comply with minimum allowable unit stresses. Indicate species and grade selected for each use and design values approved by the ALSC Board of Review.
2. For preservative-treated wood products. Indicate type of preservative used and net amount of preservative retained.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Stack wood products flat with spacers beneath and between each bundle to provide air circulation. Protect wood products from weather by covering with waterproof sheeting, securely anchored. Provide for air circulation around stacks and under coverings.

PART 2 - PRODUCTS

2.1 WOOD PRODUCTS

A. Lumber: Comply with DOC PS 20 and applicable rules of grading agencies indicated. If no grading agency is indicated, comply with the applicable rules of any rules-writing agency certified by the ALSC Board of Review. Grade lumber by an agency certified by the ALSC Board of Review to inspect and grade lumber under the rules indicated.

1. Factory mark each piece of lumber with grade stamp of grading agency.
2. For exposed lumber indicated to receive a stained or natural finish, mark grade stamp on end or back of each piece.
3. 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 wood products.
4. Dress lumber, S4S, unless otherwise indicated.

B. Maximum Moisture Content:

1. Boards: 15 percent.
2. Dimension Lumber: 15 percent unless otherwise indicated.

2.2 WOOD-PRESERVATIVE-TREATED LUMBER

A. Wood-Preservative-Treated Lumber by Pressure Process: AWPA U1, use categories as follows:

1. UC1, Interior/Dry: Interior construction continuously protected from weather or other sources of moisture. Include the following items:

   a. Wood sills, sleepers, blocking, furring, stripping, and similar concealed members in contact with masonry or concrete.
   b. Wood framing and furring attached directly to the interior of below-grade exterior masonry or concrete walls.
   c. Wood floor plates that are installed over concrete slabs-on-grade.
   d. Wood furniture.
   e. Wood millwork.

2. UC2, Interior/Damp: Interior construction protected from weather, but may be subject to sources of moisture. Include the following items:

   a. Wood sills, sleepers, blocking, furring, stripping, and similar concealed members in contact with masonry or concrete.
   b. Wood framing and furring attached directly to the interior of below-grade exterior masonry or concrete walls.
   c. Wood floor plates that are installed over concrete slabs-on-grade.
   d. Wood millwork.
   e. Wood flooring.

3. Preservative Chemicals: Acceptable to authorities having jurisdiction and containing no arsenic or chromium.

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4. For exposed items indicated to receive a stained or natural finish, chemical formulations are not to require incising, contain colorants, bleed through, or otherwise adversely affect finishes.
5. After treatment, redry dimension lumber to 19 percent maximum moisture content.

B. Kiln-dry lumber after treatment to a maximum moisture content of 19 percent. Do not use material that is warped or that does not comply with requirements for untreated material.

C. Mark lumber with treatment quality mark of an inspection agency approved by the ALSC Board of Review.

1. For exposed lumber indicated to receive a stained or natural finish, mark end or back of each piece.

D. Application: Treat items indicated on Drawings, and the following:

1. Wood cants, nailers, curbs, equipment support bases, blocking, stripping, and similar members in connection with roofing, flashing, vapor barriers, and waterproofing.
2. Wood sills, sleepers, blocking, furring, stripping, and similar concealed members in contact with masonry or concrete.
3. Wood framing and furring attached directly to the interior of below-grade exterior masonry or concrete walls.
4. Wood framing members that are less than **18 inches** above the ground in crawlspaces or unexcavated areas.
5. Wood floor plates that are installed over concrete slabs-on-grade.

2.3 FIRE-RETARDANT-TREATED LUMBER

A. General: Where fire-retardant-treated materials are indicated, materials are to comply with requirements in this article, that are acceptable to authorities having jurisdiction, and with fire-test-response characteristics specified as determined by testing identical products per test method indicated by a qualified testing agency.

B. Fire-Retardant-Treated Lumber and Plywood by Pressure Process: Products with a flame-spread index of 25 or less when tested in accordance with ASTM E84, and with no evidence of significant progressive combustion when the test is extended an additional 20 minutes, and with the flame front not extending more than **10.5 ft.** beyond the centerline of the burners at any time during the test.

1. Treatment is not to promote corrosion of metal fasteners.
2. Exterior Type: Treated materials are to comply with requirements specified above for fire-retardant-treated lumber and plywood by pressure process after being subjected to accelerated weathering in accordance with ASTM D2898. Use for exterior locations and where indicated.
3. Interior Type A: Treated materials are to have a moisture content of 28 percent or less when tested in accordance with ASTM D3201/D3201M at 92 percent relative humidity. Use where exterior type is not indicated.

C. Kiln-dry lumber after treatment to maximum moisture content of 19 percent. Kiln-dry plywood after treatment to maximum moisture content of 15 percent.

D. Identify fire-retardant-treated wood with appropriate classification marking of qualified testing agency and other information required by authorities having jurisdiction.

1. For exposed lumber indicated to receive a stained or natural finish, mark end or back of each piece.

E. For exposed items indicated to receive a stained or natural finish, chemical formulations are not to bleed through, contain colorants, or otherwise adversely affect finishes.

F. Application: Treat items indicated on Drawings, and the following:

1. Framing for raised platforms.
2. Framing for stages.
3. Concealed blocking.
4. Framing for non-load-bearing partitions.
5. Framing for non-load-bearing exterior walls.

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6. Wood cants, nailers, curbs, equipment support bases, blocking, and similar members in connection with roofing.
7. Plywood backing panels.

2.4 DIMENSION LUMBER FRAMING

A. Non-Load-Bearing Interior Partitions by Grade:

1. Grade: Construction or No. 2.
2. Application: Interior partitions not indicated as load bearing.
3. Species:

   a. Hem-fir (north); NLGA.
   b. Southern pine or mixed southern pine; SPIB.
   c. Spruce-pine-fir; NLGA.
   d. Hem-fir; WCLIB, or WWPA.
   e. Spruce-pine-fir (south); NeLMA, WCLIB, or WWPA.
   f. Northern species; NLGA.
   g. Eastern softwoods; NeLMA.
   h. Western woods; WCLIB or WWPA.

B. Framing Other Than Non-Load-Bearing Interior Partitions:

1. Application: Framing other than non-load bearing interior partitions.
2. Grade: As indicated in Drawings.
3. Species: As indicated in Drawings.

C. Exposed Framing: Hand-select material indicated to receive a stained or natural finish for uniformity of appearance and freedom from characteristics, on exposed surfaces and edges, that would impair finish appearance, including decay, honeycomb, knot-holes, shake, splits, torn grain, and wane.

1. Application: Framing Other Than Non-Load-Bearing Interior Partitions.
2. Grade: As indicated in Drawings.
3. Species: As Indicated in drawings.

2.5 MISCELLANEOUS LUMBER

A. Provide miscellaneous lumber indicated and lumber for support or attachment of other construction, including the following:

1. Blocking.
2. Nailers.
3. Rooftop equipment bases and support curbs.
4. Cants.
5. Furring.
6. Grounds.
7. Utility shelving.

B. Dimension Lumber Items:

1. Grade: Construction or No. 2.
2. Species: Any of the following species:

   a. Hem-fir (north); NLGA.
   b. Mixed southern pine or southern pine; SPIB.
   c. Spruce-pine-fir; NLGA.
   d. Hem-fir; WCLIB or WWPA.
   e. Spruce-pine-fir (south); NeLMA, WCLIB, or WWPA.
   f. Western woods; WCLIB or WWPA.
   g. Northern species; NLGA.
   h. Eastern softwoods; NeLMA.

C. Utility Shelving:

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1. Lumber Moisture Content: 19 percent maximum.
2. Species and Grade:

    a. Eastern white pine, Idaho white, lodgepole, ponderosa, or sugar pine; Premium or No. 2 Common (Sterling) grade; NeLMA, NLGA, WCLIB, or WWPA.
    b. Mixed southern pine or southern pine; No. 2 grade; SPIB.
    c. Hem-fir or hem-fir (north); Construction or No. 2 Common grade; NLGA, WCLIB, or WWPA.
    d. Spruce-pine-fir (south) or spruce-pine-fir; Construction or No. 2 Common grade; NeLMA, NLGA, WCLIB, or WWPA.

D. Concealed Boards:

1. Lumber Moisture Content: 19 percent maximum.
2. Species and Grade: Any of the following:

    a. Mixed southern pine or southern pine; No. 2 grade; SPIB.
    b. Hem-fir or hem-fir (north); Construction or No. 2 Common grade; NLGA, WCLIB, or WWPA.
    c. Spruce-pine-fir (south) or spruce-pine-fir; Construction or No. 2 Common grade; NeLMA, NLGA, WCLIB, or WWPA.
    d. Eastern softwoods; No. 2 Common grade; NeLMA.
    e. Northern species; No. 2 Common grade; NLGA.
    f. Western woods; Construction or No. 2 Common grade; WCLIB or WWPA.

E. Roofing Nailers: Structural- or No. 2-grade lumber or better; kiln-dried Douglas fir, southern pine, or wood having similar decay-resistant properties.

F. Wood Blocking: For blocking not used for attachment of other construction, Utility, Stud, or No. 3 grade lumber of any species may be used provided that it is cut and selected to eliminate defects that will interfere with its attachment and purpose.

G. Wood Furring: For furring strips for installing plywood or hardboard paneling, select boards with no knots capable of producing bent-over nails and damage to paneling.

2.6 PLYWOOD BACKING PANELS

A. Equipment Backing Panels: Plywood, DOC PS 1.

1. Grade: , fire-retardant treated.
2. Thickness: As indicated on the drawings or, if not indicated, not less than 1/2-inch nominal thickness.

2.7 FASTENERS

A. General: Fasteners are to be of size and type indicated and comply with requirements specified in this article for material and manufacture. Provide nails or screws, in sufficient length, to penetrate not less than **1-1/2 inches** into wood substrate.

1. Where rough carpentry is exposed to weather, in ground contact, pressure-preservative treated, or in area of high relative humidity, provide fasteners of Type 304 stainless steel.
2. For redwood, use stainless steel fasteners.

B. Nails, Brads, and Staples: ASTM F1667.

C. Power-Driven Fasteners: Fastener systems with an evaluation report acceptable to authorities having jurisdiction, based on ICC-ES AC70.

D. Post-Installed Anchors: Fastener systems with an evaluation report acceptable to authorities having jurisdiction, based on ICC-ES as appropriate for the substrate.

2.8 ACCESSORIES

A. Metal Framing Anchors: As indicated in the drawings.

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B. Sill-Sealer Gasket:

1. Closed-cell neoprene foam, **1/4 inch** thick, selected from manufacturer's standard widths to suit width of sill members indicated.

C. Flexible Flashing: Composite, self-adhesive, flashing product consisting of a pliable compound, bonded to a high-density polyethylene film, aluminum foil, or spunbonded polyolefin to produce an overall thickness of not less than **0.025 inch**.

1. Compound Material: Butyl rubber or rubberized asphalt.

D. Adhesives for Gluing Furring and Sleepers to Concrete or Masonry: Formulation complying with ASTM D3498 that is approved for use indicated by adhesive manufacturer.

E. Water-Repellent Preservative: Formulation containing 3-iodo-2-propynyl butylcarbamate, combined with an insecticide containing chlorpyrifos as its active ingredient.

PART 3 - EXECUTION

3.1 INSTALLATION OF ROUGH CARPENTRY, GENERAL

A. Framing Standard: Comply with AF&PA's WCD 1, "Details for Conventional Wood Frame Construction," unless otherwise indicated.

B. Set work to required levels and lines, with members plumb, true to line, cut, and fitted. Fit rough carpentry accurately to other construction. Locate furring, nailers, blocking, grounds, and similar supports to comply with requirements for attaching other construction.

C. Plywood Backing Panels: Install backing panels by fastening to studs; coordinate locations with utilities requiring backing panels. Install fire-retardant-treated plywood backing panels with classification marking of testing agency exposed to view.

D. Metal Framing Anchors: Install anchors to comply with manufacturer's written instructions. Install fasteners through each fastener hole.

E. Sill-Sealer Gasket: Install gasket to form continuous seal between sill plates and foundation walls.

F. Sill-Sealer Gasket and Termite Barrier: Install gasket and termite barrier in accordance with manufacturer's written instructions at the underside of wall bottom track or rim track and at the top of foundation wall or slab at stud or joist locations.

G. Do not splice structural members between supports unless otherwise indicated.

H. Provide blocking and framing as indicated and as required to support facing materials, fixtures, specialty items, and trim.

1. Provide metal clips for fastening gypsum board or lath at corners and intersections where framing or blocking does not provide a surface for fastening edges of panels. Space clips not more than **16 inches** o.c.

I. Provide fire blocking in furred spaces, stud spaces, and other concealed cavities as indicated and as follows:

1. Fire block furred spaces of walls, at each floor level, at ceiling, and at not more than **96 inches** o.c. with solid wood blocking or noncombustible materials accurately fitted to close furred spaces.
2. Fire block concealed spaces of wood-framed walls and partitions at each floor level, at ceiling line of top story, and at not more than **96 inches** o.c. Where fire blocking is not inherent in framing system used, provide closely fitted solid wood blocks of same width as framing members and **2-inch nominal** thickness.
3. Fire block concealed spaces between floor sleepers with same material as sleepers to limit concealed spaces to not more than **100 sq. ft.** and to solidly fill space below partitions.
4. Fire block concealed spaces behind combustible cornices and exterior trim at not more than **20 ft.** o.c.

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J. Sort and select lumber so that natural characteristics do not interfere with installation or with fastening other materials to lumber. Do not use materials with defects that interfere with function of member or pieces that are too small to use with minimum number of joints or optimum joint arrangement.

K. Field Application of Preservative Treatment: Comply with AWPA M4 for applying field treatment to cut surfaces of preservative-treated lumber.

1. Use inorganic boron (SBX) for items that are continuously protected from liquid water.
2. Use copper naphthenate for items not continuously protected from liquid water.

L. Flexible Flashing: Where wood-preservative-treated lumber is installed adjacent to metal decking, install continuous flexible flashing separator between wood and metal decking.

M. Securely attach rough carpentry work to substrate by anchoring and fastening as indicated, complying with the following:

1. Table 2304.10.1, "Fastening Schedule," in ICC's "International Building Code" (IBC).
2. Table R602.3(1), "Fastener Schedule for Structural Members," and Table R602.3(2), "Alternate Attachments," in ICC's "International Residential Code for One- and Two-Family Dwellings."
3. ICC-ES evaluation report for fastener.

N. Use steel common nails unless otherwise indicated. Select fasteners of size that will not fully penetrate members where opposite side will be exposed to view or will receive finish materials. Make tight connections between members. Install fasteners without splitting wood. Drive nails snug but do not countersink nail heads unless otherwise indicated.

3.2 INSTALLATION OF ROOFING NAILERS

A. Install roofing nailers where indicated on Drawings and where required for attaching other work. Form to shapes indicated and cut as required for true line and level of attached work. Coordinate locations with other work involved.

B. Securely attach roofing nailers to substrates by anchoring and fastening to withstand bending, shear, or other stresses imparted by Project wind loads and fastener-resistance loads as designed in accordance with ASCE/SEI 7.

C. Securely attach roofing nailers to substrate to resist the designed outward and upward wind loads indicated on Drawings and in accordance with SPRI ED-1, Tables A6 and A7.

3.3 INSTALLATION OF WOOD BLOCKING

A. Install wood blocking where indicated on Drawings and where required for attaching other work. Form to shapes indicated and cut as required for true line and level of attached work. Coordinate locations with other work involved.

B. Provide permanent grounds of dressed, pressure-preservative-treated, key-beveled lumber not less than **1-1/2 inches** wide and of thickness required to bring face of ground to exact thickness of finish material. Remove temporary grounds when no longer required.

3.4 INSTALLATION OF WOOD FURRING

A. Install wood furring level and plumb with closure strips at edges and openings. Shim with wood as required for tolerance of finish work.

B. Furring to Receive Plywood or Hardboard Paneling: Install **1-by-3-inch nominal-** size furring horizontally at 24 inches o.c.

C. Furring to Receive Gypsum Board or Plaster Lath: Install **1-by-2-inch nominal-** size furring vertically at 16 inches o.c.

3.5 INSTALLATION OF WALL AND PARTITION FRAMING

A. General: Provide single bottom plate and double top plates using members of **2-inch nominal**

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thickness whose widths equal that of studs, except single top plate may be used for non-load-bearing partitions and for load-bearing partitions where framing members bearing on partition are located directly over studs. Fasten plates to supporting construction unless otherwise indicated.

1. For exterior walls, provide 2-by-6-inch nominal- size wood studs spaced 16 inches o.c. unless otherwise indicated.
2. For interior partitions and walls, provide 2-by-6-inch nominal- size wood studs spaced 16 inches o.c. unless otherwise indicated.
3. Provide continuous horizontal blocking at midheight of partitions more than **96 inches** high, using members of **2-inch nominal** thickness and of same width as wall or partitions.

B. Construct corners and intersections with three or more studs , except that two studs may be used for interior non-load-bearing partitions.

C. Frame openings with multiple studs and headers. Provide nailed header members of thickness equal to width of studs. Support headers on jamb studs.

1. For non-load-bearing partitions, provide double-jamb studs and headers not less than **4-inch nominal** depth for openings **48 inches** and less in width, **6-inch nominal** depth for openings **48 to 72 inches** in width, **8-inch nominal** depth for openings **72 to 120 inches** in width, and not less than **10-inch nominal** depth for openings **10 to 12 ft.** in width.
2. For load-bearing walls, provide double-jamb studs for openings **60 inches** and less in width, and triple-jamb studs for wider openings. Provide headers of depth indicated or, if not indicated, in accordance with Table R602.7(1) or Table R602.7(2), as applicable, in ICC's "International Residential Code for One- and Two-Family Dwellings".

D. Provide diagonal bracing in walls, at locations indicated on Drawings, at 45-degree angle, full-story height unless otherwise indicated. Use 1-by-4-inch nominal- size boards, let-in flush with faces of studs.

3.6 INSTALLATION OF FLOOR JOIST FRAMING

A. General: Install floor joists with crown edge up and support ends of each member with not less than **1-1/2 inches** of bearing on wood or metal, or **3 inches** on masonry. Attach floor joists as follows:

1. Where supported on wood members, by toe nailing or by using metal framing anchors.
2. Where framed into wood supporting members, by using wood ledgers as indicated or, if not indicated, by using metal joist hangers.

B. Fire Cuts: At joists built into masonry, bevel cut ends **3 inches** and do not embed more than **4 inches**.

C. Frame openings with headers and trimmers supported by metal joist hangers; double headers and trimmers where span of header exceeds **48 inches**.

D. Do not notch in middle third of joists; limit notches to one-sixth depth of joist, one-third at ends. Do not bore holes larger than one-third depth of joist; do not locate closer than **2 inches** from top or bottom.

E. Provide solid blocking of **2-inch nominal** thickness by depth of joist at ends of joists unless nailed to header or band.

F. Lap members framing from opposite sides of beams, girders, or partitions not less than **4 inches** or securely tie opposing members together. Provide solid blocking of **2-inch nominal** thickness by depth of joist over supports.

G. Anchor members paralleling masonry with **1/4-by-1-1/4-inch** metal strap anchors spaced not more than **96 inches** o.c., extending over and fastening to three joists. Embed anchors at least **4 inches** into grouted masonry with ends bent at right angles and extending **4 inches** beyond bend.

H. Provide solid blocking between joists under jamb studs for openings.

I. Under non-load-bearing partitions, provide double joists separated by solid blocking equal to depth of studs above.

1. Provide triple joists separated as above, under partitions receiving ceramic tile and similar heavy finishes or fixtures.

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J. Provide bridging of type indicated below, at intervals of **96 inches** o.c., between joists.

1. Diagonal wood bridging formed from bevel-cut, **1-by-3-inch nominal-** size lumber, double-crossed and nailed at both ends to joists.
2. Steel bridging installed to comply with bridging manufacturer's written instructions.

3.7 INSTALLATION OF CEILING JOIST AND RAFTER FRAMING

A. Ceiling Joists: Install with crown edge up and complying with requirements specified above for floor joists. Face nail to ends of parallel rafters.

1. Where ceiling joists are at right angles to rafters, provide additional short joists parallel to rafters from wall plate to first joist; nail to ends of rafters and to top plate, and nail to first joist or anchor with framing anchors or metal straps. Provide **1-by-8-inch nominal-** size or **2-by-4-inch nominal-** size stringers spaced **48 inches** o.c. crosswise over main ceiling joists.

B. Rafters: Notch to fit exterior wall plates and toe nail or use metal framing anchors. Double rafters to form headers and trimmers at openings in roof framing, if any, and support with metal hangers. Where rafters abut at ridge, place directly opposite each other and nail to ridge member or use metal ridge hangers.

1. At valleys, provide double-valley rafters of size indicated or, if not indicated, of same thickness as regular rafters and **2 inches** deeper. Bevel ends of jack rafters for full bearing against valley rafters.
2. At hips, provide hip rafter of size indicated or, if not indicated, of same thickness as regular rafters and **2 inches** deeper. Bevel ends of jack rafters for full bearing against hip rafter.

C. Provide collar beams (ties) as indicated or, if not indicated, provide **1-by-6-inch nominal-** size boards between every third pair of rafters, but not more than **48 inches** o.c. Locate below ridge member, at third point of rafter span. Cut ends to fit roof slope and nail to rafters.

D. Provide special framing as indicated for eaves, overhangs, dormers, and similar conditions if any.

3.8 PROTECTION

A. Protect wood that has been treated with inorganic boron (SBX) from weather. If, despite protection, inorganic boron-treated wood becomes wet, apply EPA-registered borate treatment. Apply borate solution by spraying to comply with EPA-registered label.

END OF SECTION 06 10 00

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SECTION 06 16 00 - SHEATHING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Wall sheathing.
2. Roof sheathing.
3. Parapet sheathing.
4. Subflooring.

B. Related Requirements:

1. Section 061000 "Rough Carpentry" for plywood backing panels.
2. Section 072500 "Weather Barriers" for water-resistive barrier applied over wall sheathing.

1.2 DEFINITIONS

A. ABAA: The Air Barrier Association of America.

1.3 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1. Review air-barrier and water-resistant glass-mat gypsum sheathing requirements and installation, special details, transitions, mockups, air-leakage testing, protection, and work scheduling that covers air-barrier and water-resistant glass-mat gypsum sheathing.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of specified product. Indicate component materials and dimensions and include construction and application details.

1. Include data for wood-preservative treatment from chemical treatment manufacturer and certification by treating plant that treated plywood complies with requirements. Indicate type of preservative used and net amount of preservative retained.
2. Include data for fire-retardant treatment from chemical treatment manufacturer and certification by treating plant that treated plywood complies with requirements. Include physical properties of treated materials.
3. For fire-retardant treatments, include physical properties of treated plywood both before and after exposure to elevated temperatures, based on testing by a qualified independent testing agency in accordance with ASTM D5516.
4. For products receiving waterborne treatment, include statement that moisture content of treated materials was reduced to levels specified before shipment to Project site.
5. For air-barrier and water-resistant glass-mat gypsum sheathing, include manufacturer's technical data and tested physical and performance properties of products.

B. Shop Drawings: For air-barrier and water-resistant glass-mat gypsum sheathing assemblies.

1. Show locations and extent of sheathing, accessories, and assemblies specific to Project conditions.
2. Include details for sheathing joints and cracks, counterflashing strips, penetrations, inside and outside corners, terminations, and tie-ins with adjoining construction.
3. Include details of interfaces with other materials that form part of air barrier.

1.5 INFORMATIONAL SUBMITTALS

A. Product Certificates: From air-barrier and water-resistant glass-mat gypsum sheathing manufacturer,

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certifying compatibility of sheathing accessory materials with Project materials that connect to or that come in contact with the sheathing.

B. Product Test Reports: For each air-barrier and water-resistant glass-mat gypsum sheathing assembly, indicating compliance with specified requirements, for tests performed by a qualified testing agency.

C. Evaluation Reports: For the following, from ICC-ES:

1. Preservative-treated plywood.
2. Fire-retardant-treated plywood.
3. Foam-plastic sheathing.
4. Air-barrier and water-resistant glass-mat gypsum sheathing.
5. Power-driven fasteners.

D. Field Quality Control Reports: For specified tests and inspections.

1.6 QUALITY ASSURANCE

A. Installer Qualifications: An entity that employs installers and supervisors who are trained and approved by manufacturer of air-barrier and water-resistant glass-mat gypsum sheathing.

1. Installer is to be licensed by ABAA in accordance with ABAA's Quality Assurance Program and is to employ ABAA-certified installers and supervisors on Project.

B. Testing Agency Qualifications:

1. For testing agency providing classification marking for fire-retardant-treated material, an inspection agency acceptable to authorities having jurisdiction that periodically performs inspections to verify that the material bearing the classification marking is representative of the material tested.
2. For testing and inspecting agency providing tests and inspections related to air-barrier and water-resistant glass-mat gypsum sheathing meeting the requirements as follows:

a. Independent agency, qualified in accordance with ASTM E329 for testing indicated, and certified by ABAA.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Stack panels flat with spacers beneath and between each bundle to provide air circulation. Protect sheathing from weather by covering with waterproof sheeting, securely anchored. Provide for air circulation around stacks and under coverings.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Fire-Resistance Ratings: As tested in accordance with ASTM E119; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.

1. Fire-Resistance Ratings: Indicated by design designations from UL's "Fire Resistance Directory" or from the listings of another qualified testing agency.

B. Air-Barrier and Water-Resistant Glass-Mat Gypsum Sheathing Performance: Air-barrier and water-resistant glass-mat gypsum sheathing assembly, and seals with adjacent construction, are to be capable of performing as a continuous air barrier and as a liquid-water drainage plane flashed to discharge to the exterior incidental condensation or water penetration. Air-barrier assemblies are to be capable of accommodating substrate movement and of sealing substrate expansion and control joints, construction material changes, penetrations , tie-ins to other installed air barriers, and transitions at perimeter conditions without deterioration and air leakage exceeding specified limits.

2.2 WOOD STRUCTURAL PANEL PRODUCTS, GENERAL

A. Wood structural panels include plywood, mat-formed (nonveneer) panels such as oriented strand

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board, and composite panels, which are veneer-faced panels with mat-formed cores.

B. Thickness: As needed to comply with requirements specified, but not less than thickness indicated on Drawings.

C. Factory mark panels to indicate compliance with applicable standard.

2.3 PRESERVATIVE-TREATED PLYWOOD

A. Preservative-Treated Plywood by Pressure Process: AWPA U1, use categories as follows:

1. UC2, Interior/Damp: For interior construction not in contact with ground but may be subject to moisture.
2. UC3B, Above Ground, Exposed: For exterior construction not in contact with ground, exposed to all weather cycles including prolonged wetting.
3. UC4A, Ground Contact: For wood panels in contact with ground and exposed to all weather cycles, normal exposure conditions.
4. Preservative Chemicals: Acceptable to authorities having jurisdiction and containing no arsenic or chromium.

B. Mark plywood with appropriate classification marking of an inspection agency acceptable to authorities having jurisdiction.

C. Application: Treat items indicated on Drawings.

2.4 FIRE-RETARDANT-TREATED PLYWOOD

A. General: Where fire-retardant-treated materials are indicated, use materials complying with requirements in this article that are acceptable to authorities having jurisdiction and with fire-test-response characteristics specified as determined by testing identical products per test method indicated by a qualified testing agency.

B. Fire-Retardant-Treated Plywood by Pressure Process: Products with a flame-spread index of 25 or less when tested in accordance with ASTM E84, and with no evidence of significant progressive combustion when the test is extended an additional 20 minutes, and with the flame front not extending more than **10.5 ft.** beyond the centerline of the burners at any time during the test.

1. Treatment must not promote corrosion of metal fasteners.
2. Exterior Type: Treated materials are to comply with requirements specified above for fire-retardant-treated plywood by pressure process after being subjected to accelerated weathering in accordance with ASTM D2898. Use for exterior locations and where indicated on Drawings.
3. Interior Type A: Treated materials are to have a moisture content of 28 percent or less when tested in accordance with ASTM D3201/D3201M at 92 percent relative humidity. Use where exterior type is not indicated.
4. Design Value Adjustment Factors: Treated lumber plywood is to be tested in accordance with ASTM D5516 and design value adjustment factors are to be calculated in accordance with ASTM D6305. Span ratings after treatment are to be not less than span ratings specified.

C. Kiln-dry material after treatment to a maximum moisture content of 15 percent. Do not use material that is warped or does not comply with requirements for untreated material.

D. Identify fire-retardant-treated plywood with appropriate classification marking of qualified testing agency.

E. Application: Treat plywood indicated on Drawings, and the following:

1. Roof and wall sheathing within **48 inches** of fire walls.
2. Roof sheathing.
3. Subflooring and underlayment for raised platforms.

2.5 WALL SHEATHING

A. Plywood Sheathing, Walls :

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1. Classification: Either DOC PS 1 or DOC PS 2, Exposure 1 sheathing.
2. Span Rating: As indicated in the Drawings .
3. Nominal Thickness: Not less than 11/32 inch.

B. Oriented-Strand-Board Sheathing, Walls :

1. Classification: DOC PS 2, Exposure 1 sheathing.
2. Span Rating: As indicated in the Drawings .
3. Nominal Thickness: As indicated in the drawings .

C. Glass-Mat Gypsum Sheathing, Walls: ASTM C1177/C1177M.

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

   a. CertainTeed; Saint-Gobain North America
   b. Continental Building Products Inc.
   c. Georgia-Pacific Gypsum LLC
   d. Gold Bond Building Products, LLC provided by National Gypsum Company
   e. USG Corporation

2. Type and Thickness: Type X, 5/8 inch thick.
3. Size: 48 by 96 inches for vertical installation.

D. Cementitious Backer Units, Walls: ASTM C1325, Type A.

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. C-Cure
   b. Custom Building Products
   c. FinPan, Inc.
   d. USG Corporation

2. Thickness: 5/8 inch.

E. Fiberboard Sheathing: ASTM C208, Type IV, cellulosic fiberboard sheathing with square edges.

1. Grade: 1 (Regular).
2. Thickness: 25/32 inch.

2.6 ROOF SHEATHING

A. Plywood Sheathing, Roofs :

1. Classification: Either DOC PS 1 or DOC PS 2, Exposure 1 sheathing.
2. Span Rating: As indicated in the drawings .
3. Nominal Thickness: As indicated in the drawings 15/32 inch.

B. Oriented-Strand-Board Sheathing, Roofs :

1. Classification: DOC PS 2, Exposure 1 sheathing.
2. Span Rating: As indicated in the drawings .
3. Nominal Thickness: As indicated in the drawings .

2.7 PARAPET SHEATHING

A. Plywood Sheathing, Parapets Match wall sheathing as indicated in Drawings.

B. Oriented-Strand-Board Sheathing, Parapets Match wall sheathing as indicated in Drawings.

2.8 SUBFLOORING

A. Plywood Combination Subfloor-Underlayment :

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1. Classification: DOC PS 1, Exposure 1, Underlayment single-floor panels.
2. Nominal Thickness: Not less than 23/32 inch.
3. Edge Detail: Tongue and groove.
4. Surface Finish: Fully sanded face.

B. Oriented-Strand-Board Combination Subfloor-Underlayment :

1. Classification: DOC PS 2, Exposure 1 single-floor panels.
2. Nominal Thickness: Not less than 23/32 inch.
3. Edge Detail: Tongue and groove.
4. Surface Finish: Fully sanded face.

C. Plywood Subflooring :

1. Classification: Either DOC PS 1 or DOC PS 2, Exposure 1 single-floor panels or sheathing.
2. Nominal Thickness: Not less than 23/32 inch.

D. Oriented-Strand-Board Subflooring :

1. Classification: DOC PS 2, Exposure 1 , Structural I sheathing.
2. Nominal Thickness: Not less than 23/32 inch.

2.9 UNDERLAYMENT

A. General: Provide underlayment in nominal thicknesses indicated or, if not indicated, not less than **1/4 inch** over smooth subfloors and not less than **3/8 inch** over board or uneven subfloors.

2.10 MISCELLANEOUS MATERIALS

A. General: Provide fasteners of size and type indicated that comply with requirements specified in this article for material and manufacturer.

1. For roof parapet and wall sheathing, provide fasteners with hot-dip zinc coating complying with ASTM A153/A153M.
2. For roof parapet and wall sheathing, provide fasteners with organic-polymer or other corrosion-protective coating having a salt-spray resistance of more than 800 hours in accordance with ASTM B117.

B. Nails, Brads, and Staples: ASTM F1667.

C. Power-Driven Fasteners: Fastener systems with an evaluation report acceptable to authorities having jurisdiction, based on ICC-ES AC70.

D. Screws for Fastening Sheathing to Wood Framing: ASTM C1002.

E. Screws for Fastening Wood Structural Panels to Cold-Formed Metal Framing: ASTM C954, except with wafer heads and reamer wings, length as recommended in writing by screw manufacturer for material being fastened.

F. Screws for Fastening Gypsum Sheathing to Cold-Formed Metal Framing: Steel drill screws, in length recommended in writing by sheathing manufacturer for thickness of sheathing to be attached.

1. For steel framing less than **0.0329 inch** thick, use screws that comply with ASTM C1002.
2. For steel framing from **0.033 to 0.112 inch** thick, use screws that comply with ASTM C954.

G. Screws for Fastening Composite Nail Base Insulated Roof Sheathing to Metal Roof Deck: Steel drill screws, in type and length recommended in writing by sheathing manufacturer for thickness of sheathing to be attached, with organic-polymer or other corrosion-protective coating having a salt-spray resistance of more than 800 hours in accordance with ASTM B117. Provide washers or plates if recommended by sheathing manufacturer.

H. Sealant for Paper-Surfaced and Glass-Mat Gypsum Sheathing: Elastomeric, medium-modulus, neutral-curing silicone joint sealant compatible with joint substrates formed by gypsum sheathing and other materials, recommended in writing by sheathing manufacturer for application indicated and complying with requirements for elastomeric sealants specified in Section 079200 "Joint Sealants."

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I. Sealant for Glass-Mat Gypsum Sheathing: Silicone emulsion sealant complying with ASTM C834, compatible with sheathing tape and sheathing and recommended in writing by tape and sheathing manufacturers for use with glass-fiber sheathing tape and for covering exposed fasteners.

1. Sheathing Tape: Self-adhering glass-fiber tape, minimum **2 inches** wide, **10 by 10 or 10 by 20 threads/inch**, of type recommended in writing by sheathing and tape manufacturers for use with silicone emulsion sealant in sealing joints in glass-mat gypsum sheathing and with a history of successful in-service use.

J. Sheathing Tape for Foam-Plastic Sheathing: Pressure-sensitive plastic tape recommended in writing by sheathing manufacturer for sealing joints and penetrations in sheathing.

K. Adhesives for Field Gluing Panels to Wood Framing: Formulation complying with APA AFG-01 that is approved for use with type of construction panel indicated by manufacturers of both adhesives and panels.

PART 3 - EXECUTION

3.1 INSTALLATION, GENERAL

A. Do not use materials with defects that impair quality of sheathing or pieces that are too small to use with minimum number of joints or optimum joint arrangement. Arrange joints so that pieces do not span between fewer than three support members.

B. Cut panels at penetrations, edges, and other obstructions of work; fit tightly against abutting construction unless otherwise indicated.

C. Securely attach to substrate by fastening as indicated, complying with the following:

1. Table 2304.10.1, "Fastening Schedule," in the ICC's "International Building Code."
2. Table R602.3(1), "Fastener Schedule for Structural Members," and Table R602.3(2), "Alternate Attachments," in the ICC's "International Residential Code for One- and Two-Family Dwellings."
3. ICC-ES evaluation report for fastener.

D. Use common wire nails unless otherwise indicated. Select fasteners of size that will not fully penetrate members where opposite side will be exposed to view or will receive finish materials. Make tight connections. Install fasteners without splitting wood.

E. Coordinate wall parapet and roof sheathing installation with flashing and joint-sealant installation so these materials are installed in sequence and manner that prevent exterior moisture from passing through completed assembly.

F. Do not bridge building expansion joints; cut and space edges of panels to match spacing of structural support elements.

G. Coordinate sheathing installation with installation of materials installed over sheathing so sheathing is not exposed to precipitation or left exposed at end of the workday when rain is forecast.

3.2 INSTALLATION OF WOOD STRUCTURAL PANELS

A. General: Comply with applicable recommendations in APA Form No. E30, "Engineered Wood Construction Guide," for types of structural-use panels and applications indicated.

B. Fastening Methods: Fasten panels as indicated below:

1. Combination Subfloor-Underlayment:

a. Glue and nail to wood framing.
b. Screw to cold-formed metal framing.
c. Space panels **1/8 inch** apart at edges and ends.

2. Subflooring:

a. Glue and nail to wood framing.

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b. Screw to cold-formed metal framing.
c. Space panels **1/8 inch** apart at edges and ends.

3. Wall and Roof Sheathing:

a. Nail to wood framing. Apply a continuous bead of glue to framing members at edges of wall sheathing panels.
b. Screw to cold-formed metal framing.
c. Space panels **1/8 inch** apart at edges and ends.

4. Underlayment:

a. Nail to subflooring.
b. Space panels **1/32 inch** apart at edges and ends.
c. Fill and sand edge joints of underlayment receiving resilient flooring immediately before installing flooring.

3.3 INSTALLATION OF GYPSUM SHEATHING

A. Comply with GA and with manufacturer's written instructions.

1. Fasten gypsum sheathing to wood framing with screws.
2. Fasten gypsum sheathing to cold-formed metal framing with screws.
3. Install panels with a **3/8-inch** gap where non-load-bearing construction abuts structural elements.
4. Install panels with a **1/4-inch** gap where they abut masonry or similar materials that might retain moisture, to prevent wicking.

B. Apply fasteners so heads bear tightly against face of sheathing, but do not cut into facing.

C. Horizontal Installation: Install sheathing with V-grooved edge down and tongue edge up. Interlock tongue with groove to bring long edges in contact with edges of adjacent panels without forcing. Abut ends over centers of studs, and stagger end joints of adjacent panels not less than one stud spacing. Attach at perimeter and within field of panel to each stud.

1. Space fasteners approximately **8 inches** o.c. and set back a minimum of **3/8 inch** from edges and ends of panels.
2. For sheathing under stucco cladding, panels may be initially tacked in place with screws if overlying self-furring metal lath is screw-attached through sheathing to studs immediately after sheathing is installed.

D. Vertical Installation: Install vertical edges centered over studs. Abut ends and edges with those of adjacent panels. Attach at perimeter and within field of panel to each stud.

1. Space fasteners approximately **8 inches** o.c. and set back a minimum of **3/8 inch** from edges and ends of panels.
2. For sheathing under stucco cladding, panels may be initially tacked in place with screws if overlying self-furring metal lath is screw-attached through sheathing to studs immediately after sheathing is installed.

E. Seal sheathing joints in accordance with sheathing manufacturer's written instructions.

1. Apply elastomeric sealant to joints and fasteners and trowel flat. Apply sufficient amount of sealant to completely cover joints and fasteners after troweling. Seal other penetrations and openings.
2. Apply glass-fiber sheathing tape to glass-mat gypsum sheathing joints and apply and trowel sealant to embed entire face of tape in sealant. Apply sealant to exposed fasteners with a trowel so fasteners are completely covered. Seal other penetrations and openings.

3.4 INSTALLATION OF AIR-BARRIER AND WATER-RESISTANT GLASS-MAT GYPSUM SHEATHING

A. Install accessory materials in accordance with sheathing manufacturer's written instructions and details to form a seal with adjacent construction, to seal fasteners, and ensure continuity of air and water barrier.

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1. Coordinate the installation of sheathing with installation of roofing membrane and base flashing to ensure continuity of air barrier with roofing membrane.
2. Install transition strip on roofing membrane or base flashing, so that a minimum of **3 inches** of coverage is achieved over each substrate.

B. Connect and seal sheathing material continuously to air barriers specified under other Sections as well as to roofing-membrane air barrier, concrete below-grade structures, floor-to-floor construction, exterior glazing and window systems, glazed curtain-wall systems, storefront systems, exterior louvers, exterior door framing, and other construction used in exterior wall openings, using accessory materials.

C. Apply joint sealants forming part of air-barrier assembly within manufacturer's recommended application temperature ranges. Consult manufacturer when sealant cannot be applied within these temperature ranges.

D. Wall Openings: Prime concealed, perimeter frame surfaces of windows, curtain walls, storefronts, and doors. Apply transition strip, so that a minimum of **3 inches** of coverage is achieved over each substrate. Maintain **3 inches** of full contact over solid bearing to perimeter frames, with not less than **1 inch** of full contact.

1. Transition Strip: Roll firmly to enhance adhesion.
2. Preformed Silicone Extrusion: Set in full bed of silicone sealant applied to walls, frame, and air-barrier material.

E. Fill gaps in perimeter frame surfaces of windows, curtain walls, storefronts, doors, and miscellaneous penetrations of sheathing material with foam sealant.

F. Seal strips and transition strips around masonry reinforcing or ties and penetrations with termination mastic.

G. Seal top of through-wall flashings to sheathing with an additional **6-inch-** wide transition strip.

H. Seal exposed edges of strips at seams, cuts, penetrations, and terminations not concealed by metal counterflashings or ending in reglets with termination mastic.

I. Repair punctures, voids, and deficient lapped seams in strips and transition strips extending **6 inches** beyond repaired areas in strip direction.

3.5 INSTALLATION OF CEMENTITIOUS BACKER UNITS

A. Install panels and treat joints in accordance with ANSI A108.11 and manufacturer's written instructions for type of application indicated.

3.6 FIELD QUALITY CONTROL

A. ABAA Quality Assurance Program: Perform examinations, preparation, installation, testing, and inspections under ABAA's Quality Assurance Program.

B. Testing and Inspecting Agency: Owner will engage a qualified testing agency to perform tests and inspections.

C. Inspections: Air-barrier and water-resistant glass-mat gypsum sheathing, accessories, and installation are subject to inspection for compliance with requirements. Inspections may include the following:

1. Continuity of air-barrier system has been achieved throughout the building envelope with no gaps or holes.
2. Laps in strips and transition strips have complied with minimum requirements and have been shingled in the correct direction (or mastic has been applied on exposed edges), with no fishmouths.
3. Termination mastic has been applied on cut edges.
4. Strips and transition strips have been firmly adhered to substrate.
5. Compatible materials have been used.
6. Transitions at changes in direction and structural support at gaps have been provided.
7. Connections between assemblies (sheathing and sealants) have complied with requirements

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for cleanliness, surface preparation and priming, structural support, integrity, and continuity of seal.

8. All penetrations have been sealed.

D. Tests: As determined by testing agency from among the following tests:

1. Air-Leakage-Location Testing: Air-barrier sheathing assemblies will be tested for evidence of air leakage in accordance with ASTM E1186, chamber pressurization or depressurization with smoke tracers.
2. Air-Leakage-Volume Testing: Air-barrier assemblies will be tested for air-leakage rate in accordance with ASTM E783 or ASTM E2357.
3. Air barriers will be considered defective if they do not pass tests and inspections.

E. Repair damage to air barriers caused by testing; follow manufacturer's written instructions.

F. Prepare test and inspection reports.

END OF SECTION 06 16 00

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SECTION 06 17 15 - ENGINEERED STRUCTURAL WOOD

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Structural composite lumber.
2. Engineered rim boards.

B. Related Requirements:

1. Section 061000 "Rough Carpentry" for dimension lumber items associated with engineered structural wood.
2. Section 061753 "Shop-Fabricated Wood Trusses" for wood trusses made from dimension lumber.

1.2 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of specified product.

1. Include data on adhesives, fabrication, and protection.
2. For preservative-treated wood products, include manufacturer's written instructions for handling, storing, installing, and finishing treated material.
3. For connectors, include installation instructions.

1.4 INFORMATIONAL SUBMITTALS

A. Material Certificates: For preservative-treated wood products, from manufacturer. Indicate type of preservative used and net amount of preservative retained.

B. Research Reports: For engineered structural wood, from ICC-ES.

1.5 QUALITY ASSURANCE

A. Fabricator Qualifications: Shop that participates in a recognized quality-assurance program, complies with quality-control procedures in ASTM D5055 or ASTM D5456, and involves third-party inspection by an independent testing and inspecting agency acceptable to Architect and authorities having jurisdiction.

B. Testing Agency Qualifications: For testing agency providing classification marking for fire-retardant-treated material, an inspection agency acceptable to authorities having jurisdiction that periodically performs inspections to verify that the material bearing the classification marking is representative of the material tested.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Store, stack, and handle engineered wood products to comply with recommendations of APA EWS E705.

1. Store wrapped or banded together until ready for installation, on level well-drained area. Do not store in direct contact with the ground. Use stickers to separate bundles, spaced as recommended in writing by manufacturer.
2. Store I-joists level with the webs vertically.

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B. Do not stack other material on top of structural composite lumber or I-joists.

PART 2 - PRODUCTS

2.1 SOURCE LIMITATIONS

A. Obtain each type of engineered wood product from single source from single manufacturer.

2.2 PERFORMANCE REQUIREMENTS

A. Engineered Wood Products: Acceptable to authorities having jurisdiction and for which current model code research or evaluation reports exist that show compliance with building code in effect for Project.

1. Allowable design stresses, as published by manufacturer, are to meet or exceed those indicated. Manufacturer's published values are to be determined from empirical data or by rational engineering analysis and demonstrated by comprehensive testing performed by a qualified independent testing agency.

2.3 STRUCTURAL COMPOSITE LUMBER

A. Laminated-Veneer Lumber (LVL): Structural composite lumber made from wood veneers with grain primarily parallel to member lengths, evaluated and monitored in accordance with ASTM D5456, and manufactured with exterior-type adhesive complying with ASTM D2559.

1. Allowable Stresses:

a. Extreme Fiber Stress in Bending, Edgewise (Fb): As indicated in Drawings **-**.
b. Modulus of Elasticity, Edgewise (E): As indicated in Drawings.
c. Minimum Modulus of Elasticity (Em): As indicated in Drawings.
d. Horizontal Shear (Fv): As indicated in Drawings.
e. Tension Parallel to Grain (Ft): As indicated in Drawings.
f. Allowable Compression Stress, Parallel to the Grain (Fc): As indicated in Drawings.

2. Moisture Protection: Factory seal face, edge and ends with manufacturer's standard water-resistant coating.

B. Laminated-Strand Lumber (LSL): Structural composite lumber made from wood flake strands with grain primarily parallel to member lengths, evaluated and monitored in accordance with ASTM D5456, and manufactured with exterior-type adhesive complying with ASTM D2559.

1. Allowable Stresses:

a. Extreme Fiber Stress in Bending, Edgewise (Fb): As indicated in Drawings **-**.
b. Modulus of Elasticity, Edgewise (E): As indicated in Drawings.
c. Minimum Modulus of Elasticity (Em): As indicated in Drawings.
d. Horizontal Shear (Fv): As indicated in Drawings.
e. Tension Parallel to Grain (Ft): As indicated in Drawings.
f. Allowable Compression Stress, Parallel to the Grain (Fc): As indicated in Drawings.

2. Moisture Protection: Factory seal face, edge and ends with manufacturer's standard water-resistant coating.

2.4 ENGINEERED RIM BOARDS

A. Prefabricated, structural panel complying with APA PRR 410, APA PRR 401, or ASTM D7672 for wood frame construction and research or evaluation report for I-joists.

1. Manufacturer: Provide products by same manufacturer as I-joists.
2. Material: OSB or LVL.
3. Thickness: 1-1/8 inches.
4. Identification Marks: Comply with APA PRR-401, rim board grade.

a. Factory mark rim board with APA-EWS trademark indicating thickness, grade, and

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compliance with APA-EWS standard.

b. Factory mark rim boards with manufacturer's name, rim board series, mill identification, manufacturing date and time, name of third-party inspection agency, and ICC/CCMC code report number. Repeat identification marks at minimum **12 ft.** intervals.

2.5 PRESERVATIVE TREATMENT

A. Description: Preservative treatment; AWPA U1; Use Category UC2 for interior construction not in contact with ground, Use Category UC3B for exterior construction not in contact with ground, and Use Category UC4A for items in contact with ground.

1. Preservative Chemicals: Acceptable to authorities having jurisdiction and containing no arsenic or chromium. Do not use inorganic boron (SBX) for sill plates.
2. For exposed items indicated to receive a stained or natural finish, chemical formulations must not require incising, contain colorants, bleed through, or otherwise adversely affect finishes.

2.6 FASTENERS

A. General: Fasteners are to be of size and type indicated and to comply with requirements specified in this article for material and manufacture. Provide nails or screws, in sufficient length, to penetrate not less than **1-1/2 inches** into wood substrate.

B. Nails, Brads, and Staples: ASTM F1667.

C. Power-Driven Fasteners: Fastener systems with an evaluation report acceptable to authorities having jurisdiction, based on ICC-ES AC70.

D. Wood Screws and Lag Screws: ASME B18.2.1, ASME B18.6.1, or ICC-ES AC233.

E. Carbon Steel Bolts: ASTM A307 with **ASTM A563** hex nuts and, where indicated, flat washers all hot-dip zinc coated.

F. Stainless Steel Bolts: ASTM F593, Alloy Group 1 or 2; with **ASTM F594, Alloy Group 1 or 2** hex nuts and, where indicated, flat washers.

G. Post-Installed Anchors: Fastener systems with an evaluation report acceptable to authorities having jurisdiction, based on ICC-ES AC01 or ICC-ES AC308 as appropriate for the substrate.

2.7 METAL FRAMING ANCHORS

A. Allowable design loads, as published by manufacturer, are to meet or exceed those indicated. Manufacturer's published values are to be determined from empirical data or by rational engineering analysis and demonstrated by comprehensive testing performed by qualified independent testing agency. Framing anchors are to be punched for fasteners adequate to withstand same loads as framing anchors.

B. I-Joist Hangers: U-shaped joist hangers with seat and nailing flanges, full depth of joist, as indicated on Drawings. Nailing flanges provide lateral support at joist top chord.

1. Thickness: As indicated in Drawings.
2. Finish: Hot-dip galvanized.

C. Top Flange Hangers: U-shaped joist hangers, full depth of joist, formed from metal strap with tabs bent to extend over and be fastened to supporting member.

1. Strap Width: As indicated in Drawings .
2. Thickness: As indicated in Drawings.

D. Bridging: Rigid, V-section, nailless type, **0.050 inch** thick, length to suit joist size and spacing.

E. Post Bases: Adjustable-socket type for bolting in place with standoff plate to raise post **1 inch** above base and with **2-inch-** minimum side cover, socket **0.062 inch** thick, and standoff and adjustment plates **0.108 inch** thick.

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F. Joist Ties: Flat straps, with holes for fasteners, for tying joists together over supports.

1. Width: As indicated in Drawings .
2. Thickness: As indicated in Drawings .
3. Length: As indicated.

G. Materials: Unless otherwise indicated, fabricate from the following materials:

1. Galvanized-Steel Sheet: Hot-dip, zinc-coated steel sheet complying with ASTM A653/A653M, **G60** coating designation.

   a. Use for interior locations unless otherwise indicated.

2. Hot-Dip, Heavy-Galvanized Steel Sheet: ASTM A653/A653M; structural steel (SS), high-strength low-alloy steel Type A (HSLAS Type A), or high-strength low-alloy steel Type B (HSLAS Type B); **G185** coating designation; and not less than **0.036 inch** thick.

   a. Use for wood-preservative-treated lumber and where indicated.

3. Stainless steel bars and shapes complying with ASTM A276/A276M, Type 304.

   a. Use for exterior locations and where indicated.

2.8 MISCELLANEOUS MATERIALS

A. Sill-Sealer Gaskets:

1. Closed-cell neoprene foam, **1/4 inch** thick, selected from manufacturer's standard widths to suit width of sill members indicated.

B. Flexible Flashing: Composite, self-adhesive, flashing product consisting of pliable, butyl rubber or rubberized-asphalt compound, bonded to high-density polyethylene film, aluminum foil, or spunbonded polyolefin to produce overall thickness of not less than **0.025 inch**.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.

1. Verify that joist flange widths match hanger widths.

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

3.2 PREPARATION

A. Do not install in direct contact with concrete or masonry.

B. Where wood-preservative-treated members are installed adjacent to metal decking, install continuous flexible flashing separator between wood and metal decking.

C. Comply with AWPA M4 for applying field treatment to cut surfaces of preservative-treated lumber.

1. Use treatment approved in writing by manufacturer.

3.3 INSTALLATION OF STRUCTURAL COMPOSITE LUMBER

A. Install to comply with ESR report, manufacturer's written instructions, and applicable code.

1. Install in dry, covered conditions where average in-service moisture content of lumber is 16 percent or less.
2. Install metal framing connections in accordance with AWC's "National Design Specification (NDS) for Wood Construction." Install fasteners through each fastener hole.

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a. Connections based on NDS or manufacturer's test or code reports.

3. Install lumber plumb and level. Accurately fit, align, securely fasten, and install free from distortion or defects.
4. Provide temporary bracing to maintain lines and levels until permanent supporting members are in place.

B. Cutting: Confirm size and location of field cutting, notching, and drilling with ESR report, registered design professional, and manufacturer.

3.4 INSTALLATION OF ENGINEERED RIM BOARDS

A. Install at bearing walls perpendicular to and supported by I-joists that require full-depth blocking, or rim joists, at supports.

B. Sill Sealer Gasket: Install to form continuous seal between sill plates and foundation walls.

3.5 PROTECTION

A. Protect wood that has been treated with SBX from weather. If, despite protection, SBX-treated wood becomes wet, apply EPA-registered borate treatment. Apply borate solution by spraying to comply with EPA-registered label.

END OF SECTION 06 17 15

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SECTION 06 17 53 - SHOP-FABRICATED WOOD TRUSSES

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Wood products.
2. Preservative-treated lumber.
3. Fire-retardant-treated lumber.

1.2 DEFINITIONS

A. Metal-Plate-Connected Wood Trusses: Planar structural units consisting of metal-plate-connected members fabricated from dimension lumber and cut and assembled before delivery to Project site.

1.3 ACTION SUBMITTALS

A. Product Data: For metal-plate connectors, metal truss accessories, and fasteners.

1. Include data for wood-preservative treatment from chemical treatment manufacturer and certification from treating plant that treated materials comply with requirements. Indicate type of preservative used and net amount of preservative retained.
2. Include data for fire-retardant treatment from chemical-treatment manufacturer and certification from treating plant that treated materials comply with requirements. Include physical properties of treated materials based on testing by a qualified independent testing agency.
3. For fire-retardant treatments, include physical properties of treated lumber both before and after exposure to elevated temperatures, based on testing by a qualified independent testing agency in accordance with ASTM D5664.
4. For products receiving a waterborne treatment, include statement that moisture content of treated materials was reduced to levels specified before shipment to truss fabricator.

B. Shop Drawings: Show fabrication and installation details for trusses.

1. Show location, pitch, span, camber, configuration, and spacing for each type of truss required.
2. Indicate sizes, stress grades, and species of lumber.
3. Indicate locations of permanent bracing required to prevent buckling of individual truss members due to design loads.
4. Indicate locations, sizes, and materials for permanent bracing required to prevent buckling of individual truss members due to design loads.
5. Indicate type, size, material, finish, design values, orientation, and location of metal connector plates.
6. Show splice details and bearing details.

C. Delegated Design Submittals: For metal-plate-connected wood trusses indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

1.4 INFORMATIONAL SUBMITTALS

A. Material Certificates: For dimension lumber specified to comply with minimum specific gravity. Indicate species and grade selected for each use and specific gravity.

B. Product Certificates: For metal-plate-connected wood trusses, signed by officer of truss-fabricating firm.

C. Evaluation Reports: For the following, from ICC-ES:

1. Wood-preservative-treated lumber.

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2. Fire-retardant-treated wood.
3. Metal-plate connectors.
4. Metal truss accessories.

1.5 QUALITY ASSURANCE

A. Metal Connector-Plate Manufacturer Qualifications: A manufacturer that is a member of TPI and that complies with quality-control procedures in TPI 1 for manufacture of connector plates.

1. Manufacturer's responsibilities include providing professional engineering services needed to assume engineering responsibility.
2. Engineering Responsibility: Preparation of Shop Drawings and comprehensive engineering analysis by a qualified professional engineer.

B. Fabricator Qualifications: Shop that participates in a recognized quality-assurance program, complies with quality-control procedures in TPI 1, and involves third-party inspection by an independent testing and inspecting agency acceptable to Architect and authorities having jurisdiction.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Handle and store trusses to comply with recommendations in SBCA BCSI, "Building Component Safety Information: Guide to Good Practice for Handling, Installing, Restraining, & Bracing Metal Plate Connected Wood Trusses."

1. Store trusses flat, off of ground, and adequately supported to prevent lateral bending.
2. Protect trusses from weather by covering with waterproof sheeting, securely anchored.
3. Provide for air circulation around stacks and under coverings.

B. Inspect trusses showing discoloration, corrosion, or other evidence of deterioration. Discard and replace trusses that are damaged or defective.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Delegated Design: Engage a qualified professional engineer, as defined in Section 014000 "Quality Requirements," to design metal-plate-connected wood trusses.

B. Structural Performance: Metal-plate-connected wood trusses are to be capable of withstanding design loads within limits and under conditions indicated. Comply with requirements in TPI 1 unless more stringent requirements are specified below.

1. Design Loads: As indicated.
2. Design joists for serviceability limit states including load combinations and allowable deflections described below:

   a. Use serviceability load combinations recommended in ASCE 7 Appendix CC and described below:

      1) D + L
      2) D + Sser
      3) Where D is dead loads, L is live loads, and Sser is service level snow loads and drifts determined using 20-year MRI ground snow load maps from ASCE. See Drawings for a scale factor to derive acceptable Sser loads from unfactored strength level snow loads provided in Drawings.

   b. Allowable vertical deflections: As indicated in General Structural Notes.

C. Comply with applicable requirements and recommendations of TPI 1, TPI DSB, and SBCA BCSI.

D. Wood Structural Design Standard: Comply with applicable requirements in AF&PA's "National Design Specifications for Wood Construction" and its "Supplement."

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2.2 WOOD PRODUCTS

A. Lumber: DOC PS 20 and applicable rules of any rules-writing agency certified by the American Lumber Standard Committee (ALSC) Board of Review. Provide lumber graded by an agency certified by the ALSC Board of Review to inspect and grade lumber under the rules indicated.

1. Factory mark each piece of lumber with grade stamp of grading agency.
2. For exposed lumber indicated to receive a stained or natural finish, omit grade stamp and provide certificates of grade compliance issued by grading agency.
3. Provide dressed lumber, S4S.
4. Provide dry lumber with 19 percent maximum moisture content at time of dressing.

B. Chord Requirements for Roof Trusses

1. Orientation: Edgewise (Long dimension vertical)
2. Minimum Size: 2 by 6 inches nominal for both top and bottom chords unless indicated otherwise

C. Chord Requirements for Floor Trusses

1. Orientation: Flatwise (Long dimension horizontal)
2. Minimum Size: 3 by 6 inches nominal for top chords and 2 by 6 inches nominal bottom chords unless indicated otherwise.

D. Minimum Specific Gravity for Top Chords: 0.50.

E. Permanent Bracing: Provide wood bracing that complies with requirements for miscellaneous lumber in Section 061000 "Rough Carpentry."

2.3 PRESERVATIVE-TREATED LUMBER

A. Preservative Treatment by Pressure Process: AWPA U1; Use Category UC2 for interior construction not in contact with the ground, Use Category UC3b for exterior construction not in contact with the ground, and Use Category UC4a for items in contact with the ground.

1. Preservative Chemicals: Acceptable to authorities having jurisdiction and containing no arsenic or chromium.
2. For exposed trusses indicated to receive a stained or natural finish, use chemical formulations that do not require incising, contain colorants, bleed through, or otherwise adversely affect finishes.

B. Kiln-dry lumber after treatment to a maximum moisture content of 19 percent. Do not use material that is warped or does not comply with requirements for untreated material.

C. Mark lumber with treatment quality mark of an inspection agency approved by the ALSC Board of Review.

1. For exposed trusses indicated to receive a stained or natural finish, mark end or back of each piece.

D. Application: Treat trusses where indicated on Drawings.

2.4 FIRE-RETARDANT-TREATED LUMBER

A. General: Where fire-retardant-treated materials are indicated, use materials complying with requirements in this article, that are acceptable to authorities having jurisdiction, and with fire-test-response characteristics specified as determined by testing identical products according to test method indicated by a qualified testing agency.

B. Fire-Retardant-Treated Lumber by Pressure Process: Products with a flame-spread index of 25 or less when tested in accordance with ASTM E84, with no evidence of significant progressive combustion when the test is extended an additional 20 minutes, and with the flame front not extending more than **10.5 feet** beyond the centerline of the burners at any time during the test.

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1. Use treatment that does not promote corrosion of metal fasteners.
2. Exterior Type: Treated materials are to comply with requirements specified above for fire-retardant-treated lumber and plywood by pressure process after being subjected to accelerated weathering in accordance with ASTM D2898. Use for exterior locations and where indicated.
3. Interior Type A: Treated materials are to have a moisture content of 28 percent or less when tested in accordance with ASTM D3201 at 92 percent relative humidity. Use for interior locations where exterior type is not indicated.
4. Design Value Adjustment Factors: Treated lumber is to be tested in accordance with ASTM D5664, and design value adjustment factors is to be calculated in accordance with ASTM D6841. For enclosed roof framing and framing in attic spaces, and where high-temperature fire-retardant treatment is indicated, provide material with adjustment factors of not less than 0.85 modulus of elasticity and 0.75 for extreme fiber in bending for Project's climatological zone.

C. Kiln-dry lumber after treatment to a maximum moisture content of 19 percent.

D. Identify fire-retardant-treated wood with appropriate classification marking of testing and inspecting agency acceptable to authorities having jurisdiction.

1. For exposed trusses and bracing indicated to receive a stained or natural finish, mark end or back of each piece.

E. For exposed trusses indicated to receive a stained or natural finish, use chemical formulations that do not bleed through, contain colorants, or otherwise adversely affect finishes.

F. Application: Treat items indicated on Drawings, and the following:

1. Floor trusses.
2. Roof trusses.

2.5 METAL CONNECTOR PLATES

A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1. Alpine, a division of ITW Inc.
2. Cherokee Metal Products, Inc.; Masengill Machinery Company
3. Eagle Metal Products
4. MiTek Industries, Inc.

B. Fabricate connector plates to comply with TPI 1.

C. Hot-Dip Galvanized-Steel Sheet: ASTM A653/A653M; Structural Steel (SS), high-strength low-alloy steel Type A (HSLAS Type A), or high-strength low-alloy steel Type B (HSLAS Type B); **G60** coating designation; and not less than **0.036 inch** thick.

1. Use for interior locations unless otherwise indicated.

D. Hot-Dip Heavy-Galvanized-Steel Sheet: ASTM A653/A653M; Structural Steel (SS), high-strength low-alloy steel Type A (HSLAS Type A), or high-strength low-alloy steel Type B (HSLAS Type B); **G185** coating designation; and not less than **0.036 inch** thick.

1. Use for wood-preservative-treated lumber and where indicated.

E. Stainless Steel Sheet: ASTM A240/A240M or ASTM A666, Type 304, and not less than **0.035 inch** thick.

1. Use for exterior locations , wood-preservative-treated lumber, fire-retardant treated lumber, and where indicated.

2.6 FASTENERS

A. Provide fasteners of size and type indicated that comply with requirements specified in this article for material and manufacture.

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1. Provide fasteners for use with metal framing anchors that comply with written recommendations of metal framing manufacturer.
2. Where trusses are exposed to weather, in ground contact, made from pressure-preservative treated wood, or in area of high relative humidity, provide fasteners with hot-dip zinc coating complying with ASTM A153/A153M.

B. Nails, Brads, and Staples: ASTM F1667.

2.7 METAL FRAMING ANCHORS AND ACCESSORIES

A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1. Phoenix Metal Products, Inc.
2. Simpson Strong-Tie Co., Inc.

B. Allowable design loads, as published by manufacturer, are to comply with or exceed those indicated. Manufacturer's published values are to be determined from empirical data or by rational engineering analysis and demonstrated by comprehensive testing performed by a qualified independent testing agency. Framing anchors are to be punched for fasteners adequate to withstand same loads as framing anchors.

C. Galvanized-Steel Sheet: Hot-dip, zinc-coated steel sheet complying with ASTM A653/A653M, **G60** coating designation.

1. Use for interior locations unless otherwise indicated.

D. Hot-Dip Heavy-Galvanized-Steel Sheet: ASTM A653/A653M; Structural Steel (SS), high-strength low-alloy steel Type A (HSLAS Type A), or high-strength low-alloy steel Type B (HSLAS Type B); **G185** coating designation; and not less than **0.036 inch** thick.

1. Use for wood-preservative-treated lumber and where indicated.

E. Stainless Steel Sheet: ASTM A240/A240M or ASTM A666, Type 304.

1. Use for exterior locations and where indicated.

F. Truss Tie-Downs: Bent strap tie for fastening roof trusses to wall studs below, **1-1/2 inches** wide by **0.050 inch** thick. Tie fastens to one side of truss, top plates, and side of stud below.

G. Truss Tie-Downs (Hurricane or Seismic Ties): Bent strap tie for fastening roof trusses to wall studs below, **2-1/4 inches** wide by **0.062 inch** thick. Tie fits over top of truss and fastens to both sides of truss, top plates, and one side of stud below.

H. Roof Truss Clips: Angle clips for bracing bottom chord of roof trusses at non-load-bearing walls, **1-1/4 inches** wide by **0.050 inch** thick. Clip is fastened to truss through slotted holes to allow for truss deflection.

I. Floor Truss Hangers: U-shaped hangers, full depth of floor truss, with **1-3/4-inch-** long seat; formed from metal strap **0.062 inch** thick with tabs bent to extend over and be fastened to supporting member.

J. Roof Truss Bracing/Spacers: U-shaped channels, **1-1/2 inches** wide by **1 inch** deep by **0.040 inch** thick, made to fit between two adjacent trusses and accurately space them apart, and with tabs having metal teeth for fastening to trusses.

K. Drag Strut Connectors: Angle clip with one leg extended for fastening to the side of girder truss.

1. Angle clip is **3 by 3 by 0.179 by 8 inches** with extended leg **8 inches** long. Connector has galvanized finish.
2. Angle clip is **3 by 3 by 0.239 by 10-1/2 inches** with extended leg **10-1/2 inches** long. Connector has painted finish.

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2.8 MISCELLANEOUS MATERIALS

A. Galvanizing Repair Paint: SSPC-Paint 20, with dry film containing a minimum of 92 percent zinc dust by weight.

2.9 FABRICATION

A. Cut truss members to accurate lengths, angles, and sizes to produce close-fitting joints.

B. Fabricate metal connector plates to sizes, configurations, thicknesses, and anchorage details required to withstand design loads for types of joint designs indicated.

C. Assemble truss members in design configuration indicated; use jigs or other means to ensure uniformity and accuracy of assembly, with joints closely fitted to comply with tolerances in TPI 1. Position members to produce design camber indicated.

1. Fabricate wood trusses within manufacturing tolerances in TPI 1.

D. Connect truss members by metal connector plates located and securely embedded simultaneously in both sides of wood members by air or hydraulic press.

2.10 SOURCE QUALITY CONTROL

A. Special Inspections: Owner will engage a qualified special inspector to perform special inspections.

1. Provide special inspector with access to fabricator's documentation of detailed fabrication and quality-control procedures that provide a basis for inspection control of the workmanship and the fabricator's ability to conform to approved construction documents and referenced standards.
2. Provide special inspector with access to places where wood trusses are being fabricated to perform inspections.

B. Correct deficiencies in Work that special inspections indicate do not comply with the Contract Documents.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install wood trusses only after supporting construction is in place and is braced and secured.

B. If trusses are delivered to Project site in more than one piece, assemble trusses before installing.

C. Hoist trusses in place by lifting equipment suited to sizes and types of trusses required, exercising care not to damage truss members or joints by out-of-plane bending or other causes.

D. Install and brace trusses according to TPI recommendations and as indicated.

E. Install trusses plumb, square, and true to line and securely fasten to supporting construction.

F. Space trusses as indicated; adjust and align trusses in location before permanently fastening.

G. Anchor trusses securely at bearing points; use metal truss tie-downs or floor truss hangers as applicable. Install fasteners through each fastener hole in metal framing anchors according to manufacturer's fastening schedules and written instructions.

H. Securely connect each truss ply required for forming built-up girder trusses.

1. Anchor trusses to girder trusses as indicated.

I. Install and fasten permanent bracing during truss erection and before construction loads are applied. Anchor ends of permanent bracing where terminating at walls or beams.

1. Install bracing to comply with Section 061000 "Rough Carpentry."

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2. Install and fasten strongback bracing vertically against vertical web of parallel-chord floor trusses at centers indicated.

J. Install wood trusses within installation tolerances in TPI 1.

K. Do not alter trusses in field. Do not cut, drill, notch, or remove truss members.

L. Replace wood trusses that are damaged or do not comply with requirements.

1. Damaged trusses may be repaired according to truss repair details signed and sealed by the qualified professional engineer responsible for truss design, when approved by Architect.

3.2 REPAIRS AND PROTECTION

A. Protect wood that has been treated with inorganic boron (SBX) from weather. If, despite protection, inorganic boron-treated wood becomes wet, apply EPA-registered borate treatment. Apply borate solution by spraying to comply with EPA-registered label.

B. Protect wood trusses from weather. If, despite protection, wood trusses become wet, apply EPA-registered borate treatment. Apply borate solution by spraying to comply with EPA-registered label.

C. Repair damaged galvanized coatings on exposed surfaces in accordance with ASTM A780/A780M and manufacturer's written instructions.

3.3 FIELD QUALITY CONTROL

A. Special Inspections: Owner will engage a qualified special inspector to perform special inspections to verify that temporary installation restraint/bracing and the permanent individual truss member restraint/bracing are installed in accordance with the approved truss submittal package.

END OF SECTION 06 17 53

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SECTION 06 18 00 - GLUED-LAMINATED CONSTRUCTION

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Structural glued-laminated timber.
2. Timber connectors.

B. Related Requirements:

1. Section 061000 "Rough Carpentry" for dimension lumber items associated with structural glued-laminated timber.

1.2 DEFINITIONS

A. Structural Glued-Laminated (Glulam) Timber: An engineered, stress-rated timber product assembled from selected and prepared wood laminations bonded together with adhesives and with the grain of the laminations approximately parallel longitudinally.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of specified product.

1. Include data on lumber, adhesives, fabrication, and protection.
2. For preservative-treated wood products. Include chemical treatment manufacturer's written instructions for handling, storing, installing, and finishing treated material.
3. For connectors. Include installation instructions.

B. Shop Drawings:

1. Show layout of structural glued-laminated timber system and full dimensions of each member.
2. Indicate species and laminating combination.
3. Include large-scale details of connections.

C. Delegated Design Submittals: For structural glued-laminated timber and timber connectors.

1.4 INFORMATIONAL SUBMITTALS

A. Certificates of Conformance: Issued by a qualified testing and inspecting agency indicating that structural glued-laminated timber complies with requirements in ANSI A190.1.

B. Material Certificates: For preservative-treated wood products, from manufacturer. Indicate type of preservative used and net amount of preservative retained.

C. Research/Evaluation Reports: For structural glued-laminated timber, from ICC-ES.

1.5 QUALITY ASSURANCE

A. Manufacturer Qualifications: An AITC- or APA-EWS-licensed firm.

1.6 DELIVERY, STORAGE, AND HANDLING

A. General: Comply with provisions in AITC 111.

B. Individually wrap members using plastic-coated paper covering with water-resistant seams.

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PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Delegated Design: Engage a qualified professional engineer, as defined in Division 01 Section "Quality Requirements," to design structural glued-laminated timber and connectors.

B. Structural Performance: Structural glued-laminated timber and connectors are to withstand the effects of structural loads shown on Drawings without exceeding allowable design working stresses listed in ANSI 117 or determined according to ASTM D3737 and acceptable to authorities having jurisdiction.

C. Seismic Performance: Structural glued-laminated timber and connectors are to withstand the effects of earthquake motions determined according to ASCE/SEI 7.

2.2 STRUCTURAL GLUED-LAMINATED TIMBER

A. General: Provide structural glued-laminated timber that complies with ANSI A190.1 and ANSI 117 or research/evaluation reports acceptable to authorities having jurisdiction.

1. Factory mark each piece of structural glued-laminated timber with AITC Quality Mark or APA-EWS trademark. Place mark on surfaces that are not exposed in the completed Work.
2. Provide structural glued-laminated timber made from single species.
3. Provide structural glued-laminated timber made from solid lumber laminations; do not use laminated veneer lumber.
4. Provide structural glued-laminated timber made with wet-use adhesive complying with ANSI A190.1.

B. Species and Grades for Structural Glued-Laminated Timber:

1. As noted in General Structural Notes .

C. Appearance Grade: Framing, complying with AITC 110.

2.3 PRESERVATIVE TREATMENT

A. Preservative Treatment: Where preservative-treated structural glued-laminated timber is indicated, comply with AWPA U1, Use Category 1.

2.4 TIMBER CONNECTORS

A. Fabricate beam seats from steel with 3/8-inch bearing plates, **3/4-inch-** diameter-by-**12-inch-** long deformed bar anchors, and **0.239-inch** side plates.

B. Fabricate arch base shoes from steel with **1-inch** baseplates and **3/8-inch** side plates.

C. Fabricate beam hangers from steel with **0.179-inch** stirrups and **0.239-inch** top plates.

D. Fabricate hinge connectors from steel with **0.179-inch** side plates and 3/4-inch top and bottom plates.

E. Fabricate strap ties from steel, 2-1/2 inches wide by 0.179 inch thick.

F. Fabricate tie rods from round steel bars with upset threads connected with forged-steel turnbuckles complying with ASTM A668/A668M.

G. Provide bolts, **7/8 inch** unless otherwise indicated, complying with **ASTM A307, Grade A**; nuts complying with **ASTM A563**; and, where indicated, flat washers.

H. Provide shear plates, 4 inches in diameter, complying with ASTM D5933.

I. Materials: Unless otherwise indicated, fabricate from the following materials:

1. Structural-steel shapes, plates, and flat bars complying with ASTM A36/A36M.
2. Round steel bars complying with ASTM A575, Grade M 1020.
3. Hot-rolled steel sheet complying with ASTM A1011/A1011M, Structural Steel, Type SS, Grade

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33.

J. Finish steel assemblies and fasteners with rust-inhibitive primer, **2-mil** dry film thickness.

K. Hot-dip galvanize steel assemblies and fasteners after fabrication to comply with ASTM A123/A123M or ASTM A153/A153M.

2.5 MISCELLANEOUS MATERIALS

A. End Sealer: Manufacturer's standard, transparent, colorless wood sealer that is effective in retarding the transmission of moisture at cross-grain cuts and is compatible with indicated finish.

B. Penetrating Sealer: Manufacturer's standard, transparent, penetrating wood sealer that is compatible with indicated finish.

2.6 FABRICATION

A. Shop fabricate for connections to greatest extent possible, including cutting to length and drilling bolt holes.

1. Dress exposed surfaces as needed to remove planing and surfacing marks.

B. Camber: Fabricate horizontal and inclined members of less than 1:1 slope with either circular or parabolic camber equal to 1/500 of span.

C. Where preservative-treated members are indicated, fabricate (cut, drill, surface, and sand) before treatment to greatest extent possible. Where fabrication must be done after treatment, apply a field-treatment preservative to comply with AWPA M4.

1. Use inorganic boron (SBX) treatment for members not in contact with the ground and continuously protected from liquid water.
2. Use copper naphthenate treatment for members in contact with the ground or not continuously protected from liquid water.

D. End-Cut Sealing: Immediately after end cutting each member to final length and after preservative treatment, apply a saturation coat of end sealer to ends and other cross-cut surfaces, keeping surfaces flood coated for not less than 10 minutes.

E. Seal Coat: After fabricating, sanding, and end-coat sealing, apply a heavy saturation coat of penetrating sealer on surfaces of each unit .

2.7 FACTORY FINISHING

A. Clear Finish: Manufacturer's standard, resistant to mildew and fungus.

1. Water repellent.
2. Film-forming two-coat, urethane.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates in areas to receive structural glued-laminated timber, with Installer present, for compliance with requirements, installation tolerances, and other conditions affecting performance of the Work.

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

3.2 INSTALLATION

A. General: Erect structural glued-laminated timber true and plumb and with uniform, close-fitting joints. Provide temporary bracing to maintain lines and levels until permanent supporting members are in

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place.

1. Handle and temporarily support glued-laminated timber to prevent surface damage, compression, and other effects that might interfere with indicated finish.

B. Framing Built into Masonry: Provide **1/2-inch** clearance at tops, sides, and ends of members built into masonry; bevel cut ends **3 inches**; and do not embed more than **4 inches** unless otherwise indicated.

C. Cutting: Avoid extra cutting after fabrication. Where field fitting is unavoidable, comply with requirements for shop fabrication.

D. Fit structural glued-laminated timber by cutting and restoring exposed surfaces to match specified surfacing and finishing.

1. Predrill for fasteners using timber connectors as templates.
2. Finish exposed surfaces to remove planing or surfacing marks and to provide a finish equivalent to that produced by machine sanding with No. 120 grit sandpaper.
3. Coat cross cuts with end sealer.
4. Where preservative-treated members must be cut during erection, apply a field-treatment preservative to comply with AWPA M4.

   a. Use inorganic boron (SBX) treatment for members not in contact with the ground and continuously protected from liquid water.
   b. Use copper naphthenate treatment for members in contact with the ground or not continuously protected from liquid water.

E. Install timber connectors as indicated.

1. Unless otherwise indicated, install bolts with same orientation within each connection and in similar connections.
2. Install bolts with orientation as indicated or, if not indicated, as directed by Architect.

3.3 ADJUSTING

A. Repair damaged surfaces and finishes after completing erection. Replace damaged structural glued-laminated timber if repairs are not approved by Architect.

3.4 PROTECTION

A. Do not remove wrappings on individually wrapped members until they no longer serve a useful purpose, including protection from weather, sunlight, soiling, and damage from work of other trades.

1. Coordinate wrapping removal with finishing work. Retain wrapping where it can serve as a painting shield.
2. Slit underside of wrapping to prevent accumulation of moisture inside the wrapping.

END OF SECTION 06 18 00

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SECTION 06 41 00 - ARCHITECTURAL WOOD CASEWORK

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Wood-veneer-faced casework for transparent finish.
2. Wood-veneer-faced casework for opaque finish.
3. Plastic-laminate-clad casework.
4. Wood materials.
5. Glass.
6. Casework hardware.
7. Accessories.
8. Shop finishing.

B. Related Requirements:

1. Section 061000 "Rough Carpentry" for wood furring, blocking, shims, and hanging strips required for installing cabinets that are concealed within other construction before cabinet installation.
2. Section 092216 "Non-Structural Metal Framing" for standard, interior non-load-bearing, metal-stud-framing required for anchoring cabinets.
3. Section 123623.13 "Plastic-Laminate-Clad Countertops." Section 123661 "Simulated Stone Countertops."

1.2 COORDINATION

A. Coordinate sizes and locations of framing, blocking, furring, reinforcements, and other related units of Work specified in other Sections to support loads imposed by installed and fully loaded cabinets.

B. Hardware Coordination: Distribute copies of approved hardware schedule specified in Section 087100 "Door Hardware" to manufacturer of architectural cabinets; coordinate Shop Drawings and fabrication with hardware requirements.

1.3 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1. Review locations and method of attachment of backing required for casework installation.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of specified product.

1. Include panel material description and finish.
2. Include glazing.
3. Include accessories.
4. Include hardware.
5. Include shop finishing.

B. Shop Drawings:

1. Plans, elevations, sections, and attachment details.

   a. Show large-scale details.
   b. Show locations and sizes of furring, blocking, and hanging strips, including concealed blocking and reinforcement specified in other Sections.
   c. Show locations and sizes of cutouts and holes for items installed in architectural cabinets.

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d. Show veneer leaves with dimensions, grain direction, exposed face, and identification numbers indicating the flitch and sequence within the flitch for each leaf.

C. Samples for Initial Selection: For each exposed product and for each color and finish specified, in manufacturer's standard size.

D. Samples for Verification: Provide a minimum of three samples showing the full range of color and/or grain to be expected in the finished work, for the following.

1. Lumber for Transparent Finish: Not less than **8 inches** long by **3/4 inch** thick, and as wide as practical, for each species and cut, finished on one side and one edge.
2. Veneer Leaves: Representative of and selected from flitches to be used for transparent-finished cabinets. Samples to show the full range of color and grain to be expected.
3. Veneer Panel for Transparent Finish: **8 by 8 inches** by **1/4 inch**, representative of and selected from flitches to be used for transparent-finished casework.
4. Lumber and Panel Products with Shop-Applied Opaque Finish: Not less than **8 inches** long by **3/4 inches** thick, and as wide as practical, for each species and cut for lumber and **8 by 10 inches** for panels, for each finish system and color.

   a. Finish entire exposed surface.

5. Plastic Laminates: **8 by 8 inches**, for each type, color, pattern, and surface finish required.

   a. Provide one Sample applied to core material with specified edge material applied to one edge.

6. Thermally Fused Laminate (TFL) Panels: **8 by 10 inches**, for each color, pattern, and surface finish.

   a. Provide edgebanding on one edge.

7. Corner Pieces:

   a. Cabinet-front frame joints between stiles and rails and at exposed end pieces, **18 inches** high by **18 inches** wide by **6 inches** deep.
   b. Miter joints for standing trim.

8. Exposed Cabinet Hardware and Accessories: One full-size unit for each type and finish.

1.5 INFORMATIONAL SUBMITTALS

A. Product Certificates: For each type of product.

1. Composite wood products.
2. Thermally fused laminate (TFL) panels.
3. Glass.
4. Adhesives.

B. Field quality control reports.

C. Qualification Statements: For manufacturer and Installer.

1.6 CLOSEOUT SUBMITTALS

A. Quality Standard Compliance Certificates: AWI QCP Certificate.

1.7 QUALITY ASSURANCE

A. Manufacturer Qualifications: Employs skilled workers who custom fabricate products similar to those required for this Project and whose products have a record of successful in-service performance.

1. Manufacturer's Certification: Licensed participant in AWI's Quality Certification Program.

B. Installer Qualifications: Manufacturer of products.

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1.8 DELIVERY, STORAGE, AND HANDLING

A. Do not deliver cabinets until painting and similar finish operations that might damage architectural cabinets have been completed in installation areas. Store cabinets in installation areas or in areas where environmental conditions comply with requirements specified in "Field Conditions" Article.

1.9 FIELD CONDITIONS

A. Environmental Limitations without Humidity Control: Do not deliver or install cabinets until building is enclosed, wet-work is complete, and HVAC system is operating and maintaining temperature and relative humidity at levels planned for building occupants during the remainder of the construction period.

B. Environmental Limitations with Humidity Control: Do not deliver or install cabinets until building is enclosed, wet-work is complete, and HVAC system is operating and maintaining temperature between **60 and 90 deg F** and relative humidity between 30 and 55 percent during the remainder of the construction period.

C. Field Measurements: Where cabinets are indicated to fit to other construction, verify dimensions of other construction by field measurements before fabrication, and indicate measurements on Shop Drawings. Coordinate fabrication schedule with construction progress to avoid delaying the Work.

1. Locate concealed framing, blocking, and reinforcements that support cabinets by field measurements before being enclosed/concealed by construction, and indicate measurements on Shop Drawings.

D. Established Dimensions: Where cabinets are indicated to fit to other construction, establish dimensions for areas where cabinets are to fit. Provide allowance for trimming at site, and coordinate construction to ensure that actual dimensions correspond to established dimensions.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Unless otherwise indicated, comply with ANSI/AWI 0641 for duty level and grade of architectural cabinets indicated for construction, finishes, installation, and other requirements.

1. The Contract Documents contain requirements that are more stringent than the referenced woodwork quality standard. Comply with requirements of the Contract Documents in addition to those of the referenced quality standard.

2.2 WOOD-VENEER-FACED CASEWORK FOR TRANSPARENT FINISH

A. Architectural Woodwork Institute (AWI) Standard:

1. Structural Performance Duty Level: 1 - Light Commercial, 2 - Commercial, 3 - Institutional, 4 - Laboratory .
2. Aesthetic Performance Grade: Custom.

B. Casework Construction Type: Frameless.

C. Door and Drawer-Front:

1. Design: Flush panel or as indicated on plans .
2. Style: Flush overlay or as indicated on plans .

a. Reveal Dimension: As indicated on Drawings.

D. Exposed Interior Surfaces: As indicated on Drawings.

1. Species: As indicated on Drawings.
2. Cut: Plain sliced/plain sawn.
3. Veneer Matching: Match exposed exterior surfaces.

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4. Edgeband: Match exposed exterior surfaces.

E. Semiexposed Surfaces:

1. Surfaces Other Than Drawer Bodies: Same species wood veneer panel indicated for exposed surfaces.
2. Drawer Subfronts, Backs, and Sides: Solid-hardwood lumber, same species indicated for exposed surfaces.
3. Drawer Bottoms: Hardwood plywood.
4. Shelves: Adjustable.

   a. Loading Capacity: 50 lb/sq. ft.

5. Edgeband: Match exposed surfaces.

2.3 WOOD-VENEER-FACED CASEWORK FOR OPAQUE FINISH

A. Architectural Woodwork Institute (AWI) Standard:

1. Structural Performance Duty Level: 1 - Light Commercial, 2 - Commercial, 3 - Institutional, 4 - Laboratory, .
2. Aesthetic Performance Grade: Custom.

B. Casework Construction Type: Frameless.

C. Door and Drawer-Front:

1. Design: Flush panel or as indicated on plans .
2. Style: Flush overlay or as indicated on plans .

   a. Reveal Dimension: As indicated on Drawings.

D. Exposed Exterior Surfaces: Any closed-grain hardwood suitable for opaque finish.

1. Edgeband: Solid wood matching exposed surfaces.

E. Exposed Interior Surfaces: Any closed-grain hardwood suitable for opaque finish.

1. Edgeband: Solid wood.

F. Semiexposed Surfaces:

1. Surfaces Other Than Drawer Bodies: Match materials indicated for exposed surfaces.
2. Drawer Sides and Backs: Solid birch or maple hardwood lumber.
3. Drawer Bottoms: Hardwood plywood.
4. Shelves: Adjustable.

   a. Loading Capacity: 50 lb/sq. ft.

5. Edgeband:

   a. Edges of Veneer Panels: Solid wood compatible for color and grain of exposed surfaces.
   b. Edges of Thermally Fused Laminate (TFL) Panels: PVC or ABS, 0.018-inch minimum thickness.

2.4 PLASTIC-LAMINATE-CLAD CASEWORK

A. Architectural Woodwork Institute (AWI) Standard:

1. Structural Performance Duty Level: 1 - Light Commercial, 2 - Commercial, 3 - Institutional, 4 - Laboratory .
2. Aesthetic Performance Grade: Custom.

B. Casework Construction Type: Frameless.

C. Door and Drawer-Front:

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1. Design: Flush panel or as indicated on plans .
2. Style: Flush overlay or as indicated on plans.

    a. Reveal Dimension: As indicated on Drawings.

D. High-Pressure Decorative Laminate (HPDL): ISO 4586-3, grades as indicated or, if not indicated, as required by quality standard.

E. Colors, Patterns, and Finishes: Provide materials and products that result in colors and textures of exposed laminate surfaces complying with the following requirements:

1. As indicated by laminate manufacturer's designations.

F. Exposed Exterior Surfaces:

1. Plastic-Laminate Grade: HGS or VGS.
2. Pattern Direction: Vertically for drawer fronts, doors, and fixed panels Horizontally for drawer fronts, doors, and fixed panels.
3. Edgebanding: High-pressure decorative laminate (HPDL).

G. Exposed Interior Surfaces: High-pressure decorative laminate (HPDL) the same color and pattern as exposed exterior surfaces.

1. Edgebanding: High-pressure decorative laminate (HPDL).

H. Semiexposed Surfaces:

1. Surfaces Other Than Drawer Bodies: High-pressure decorative laminate (HPDL) cabinet liner Grade CLS, ISO 4586-3.
2. Drawer Sides and Backs: Solid-hardwood lumber.
3. Concealed Backs of Panels with Exposed Plastic-Laminate Surfaces: High-pressure decorative laminate (HPDL), ISO 4583-3, grade to match exposed surface.
4. Drawer Bottoms: Hardwood plywood.
5. Shelves: Adjustable.

    a. Loading Capacity: 50 lb/sq. ft.

6. Edgebanding: High-pressure decorative laminate (HPDL).

2.5 WOOD MATERIALS

A. Wood Products: Provide materials that comply with requirements of referenced quality standard for each type of architectural cabinet and quality grade specified unless otherwise indicated.

1. Do not use plain-sawn softwood lumber with exposed, flat surfaces more than **3 inches** wide.
2. Wood Moisture Content:

    a. Non-Climate-Controlled Environments: 7 to 12 percent.
    b. Climate-Controlled Environments: 6 to 10 percent.

B. Composite Wood Products: Provide materials that comply with requirements of referenced quality standard for each type of architectural cabinet and quality grade specified unless otherwise indicated.

1. Medium-Density Fiberboard (MDF): ANSI A208.2, Grade 130.
2. Particleboard (Medium Density): ANSI A208.1, Grade M-2.
3. Softwood Plywood: DOC PS 1 , medium-density overlay.
4. Veneer-Faced Panel Products (Hardwood Plywood): HPVA HP-1.
5. Thermally Fused Laminate (TFL) Panels: Particleboard or MDF finished with thermally fused, melamine-impregnated decorative paper and complying with requirements of AWI 300.

2.6 CASEWORK HARDWARE

A. Cabinet Hardware: Provide cabinet hardware and accessory materials associated with architectural cabinets except for items specified in Section 087100 "Door Hardware."

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B. Hinges:

1. Butt Hinges: **2-3/4-inch**, Grade 1 five-knuckle steel hinges made from **0.095-inch-** thick metal, and as follows:

   a. Semi-Concealed Hinges, Back Mounted, for Flush Doors: ANSI/BHMA A156.9, B01361.
   b. Semi-Concealed Hinges, Back Mounted, for Overlay Doors: ANSI/BHMA A156.9, B01511.

2. Frameless Concealed Hinges (European Type): ANSI/BHMA A156.9, B01602, 95-110 degrees of opening , with integral soft-close damper.

C. Pulls and Knobs:

1. Back-Mounted Pulls: ANSI/BHMA A156.9, B02011, **3-inch** centers.
2. Wire Pulls: Back mounted, solid metal, 4 inches long, 5/16 inch in diameter.
3. Back-Mounted Knobs: ANSI/BHMA A156.9, B02041.

D. Catches and Latches:

1. Magnetic Catches: ANSI/BHMA A156.9, B03141.
2. Push-in Magnetic Catches: ANSI/BHMA A156.9, B03132.
3. Roller Catches, Double Rollers: ANSI/BHMA A156.9, B03072.
4. Ball Friction Catches: ANSI/BHMA A156.9, B03013.

E. Shelf Rests and Standards:

1. Adjustable Shelf Standards and Supports: ANSI/BHMA A156.9, B04071; with shelf rests, B04081.
2. Shelf Rests: ANSI/BHMA A156.9, B04013; metal.

F. Drawer Slides: ANSI/BHMA A156.9.

1. Standard Duty (Grade 1 and Grade 2): Side mount and extending under bottom edge of drawer.
2. Drawer Types:

   a. Pencil drawers not more than **3 inches** high and not more than **24 inches** wide provide 50 lb load capacity.
   b. General-purpose drawers more than **3 inches** high, but not more than **6 inches** high and not more than **24 inches** wide, provide 75 lb load capacity.
   c. File drawers more than **6 inches** high or more than **24 inches** wide provide 100 lb load capacity.
   d. Lateral file drawers more than **6 inches** high and more than **24 inches**, but not more than **30 inches** wide, provide 150 lb load capacity.
   e. Lateral file drawers more than **6 inches** high and more than **30 inches** wide provide 200 lb load capacity.
   f. Computer keyboard tray provides 75 lb load capacity.

G. Tracks for Sliding Glass Doors: Recessed mounting, ANSI/BHMA A156.9, B07063; aluminum.

H. Locks for Drawer and Hinged-Doors: Cylindrical (cam) type, five-pin tumbler, brass with chrome-plated finish, and complying with ANSI/BHMA A156.11, Grade 1.

1. Provide a minimum of two keys per lock and six master keys.
2. Provide locks where indicated.

I. Door Bumpers: Manufacturer's standard self-adhering clear silicone pads.

J. Hardware Finish:

1. Exposed Hardware: Provide finish that complies with ANSI/BHMA A156.18 for ANSI/BHMA finish number indicated.

   a. Dark, Oxidized, Satin Bronze, Oil Rubbed: ANSI/BHMA 613 for bronze base; ANSI/BHMA 640 for steel base.

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b. Bright Brass, Clear Coated: ANSI/BHMA 605 for brass base; ANSI/BHMA 632 for steel base.
c. Bright Brass, Vacuum Coated: ANSI/BHMA 723 for brass base; ANSI/BHMA 729 for zinc-coated-steel base.
d. Satin Brass, Blackened, Bright Relieved, Clear Coated: ANSI/BHMA 610 for brass base; ANSI/BHMA 636 for steel base.
e. Satin Chromium Plated: ANSI/BHMA 626 for brass or bronze base; ANSI/BHMA 652 for steel base.
f. Bright Chromium Plated: ANSI/BHMA 625 for brass or bronze base; ANSI/BHMA 651 for steel base.
g. Satin Stainless Steel: ANSI/BHMA 630.

2. Concealed Hardware: Manufacturer's standard finish that complies with product class requirements in ANSI/BHMA A156.9.

2.7 ACCESSORIES

A. Grommets:

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. Doug Mockett & Company, Inc.
b. Hafele America Co.
c. W.W. Grainger, Inc.

2. Wire-Management Grommets: Circular, grommets and matching caps with slot for wire passage.

a. Finish: Molded plastic.
b. Outside Diameter: 2 inches.
c. Color: Black.

2.8 FABRICATION

A. Fabricate architectural cabinets to dimensions, profiles, and details indicated. Ease sharp edges and corners.

B. Complete fabrication, including assembly and hardware application, to maximum extent possible before shipment to Project site. Disassemble components only as necessary for shipment and installation. Where necessary for fitting at site, provide ample allowance for scribing, trimming, and fitting.

1. Trial fit assemblies at manufacturer's shop that cannot be shipped completely assembled. Install dowels, screws, bolted connectors, and other fastening devices that can be removed after trial fitting. Verify that various parts fit as intended and check measurements of assemblies against field measurements before disassembling for shipment.

C. Shop-cut openings to maximum extent possible to receive hardware, appliances, electrical work, and similar items. Locate openings accurately and use templates or roughing-in diagrams to produce accurately sized and shaped openings. Sand edges of cutouts to remove splinters and burrs.

D. Install glass to comply with applicable requirements in Section 088000 "Glazing" and in NGA's "GANA Glazing Manual."

1. For glass in wood frames, secure glass with removable stops.
2. For exposed glass edges, polish and grind smooth.

2.9 SHOP FINISHING

A. Finish architectural cabinets at manufacturer's shop as specified in this Section. Defer only final touchup, cleaning, and polishing until after installation.

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B. Shop-finish transparent-finished architectural cabinets at manufacturer's shop as specified in this Section. See Section 099123 "Interior Painting" for field finishing of opaque-finished architectural cabinets.

C. Drawings indicate items that are required to be shop finished. Finish these items at manufacturer's shop as specified in this Section. See Section 099123 "Interior Painting" for field finishing of architectural cabinets.

D. Shop Priming: Shop apply the prime coat including backpriming, if any, for transparent-finished items specified to be field finished. See Section 099123 "Interior Painting" for material and application requirements.

E. Preparation for Finishing: Comply with referenced quality standard for sanding, filling countersunk fasteners, sealing concealed surfaces, and similar preparations for finishing architectural cabinets, as applicable to each unit of work.

1. Backpriming: Apply one coat of sealer or primer, compatible with finish coats, to concealed surfaces of cabinets.

F. Transparent Finish:

1. Aesthetic Performance Grade: Custom.
2. Finish System: TR-3, latex acrylic, water-based.
3. Wash Coat for Closed-Grain Woods: Apply wash-coat sealer to cabinets made from closed-grain wood before staining and finishing.
4. Staining: Match approved sample for color.
5. Open Finish for Open-Grain Woods: Do not apply filler to open-grain woods.
6. Filled Finish for Open-Grain Woods: After staining, apply wash-coat sealer and allow to dry. Apply paste wood filler and wipe off excess. Tint filler to match stained wood.
7. Sheen: Satin, 31-45 gloss units measured on 60-degree gloss meter per ASTM D523.

G. Opaque Finish:

1. Aesthetic Performance Grade: Custom.
2. Finish System: OP-3, latex acrylic, water-based.
3. Color: As selected by Architect from manufacturer's full range.
4. Sheen: Satin, 31-45 gloss units measured on 60-degree gloss meter per ASTM D523.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas, with Installer present, for compliance with requirements for installation tolerances, location of reinforcements, and other conditions affecting performance of the Work.

1. Confirm location and adequacy of blocking and supports required for installation.
2. Verify size and locations of cutouts for appliances, special equipment, sinks, plumbing, and other items to be mounted in or adjacent to casework.

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

3.2 PREPARATION

A. Before installation, condition cabinets to humidity conditions in installation areas for not less than 72 hours.

3.3 INSTALLATION OF CASEWORK

A. Install casework to comply with requirements of the structural and aesthetic performance specified.

B. Assemble cabinets and complete fabrication at Project site to extent that it was not completed in the shop.

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C. Install cabinets level, plumb, and true in line to a tolerance of **1/8 inch in 96 inches** using concealed shims.

1. Scribe and cut cabinets to fit adjoining work, refinish cut surfaces, and repair damaged finish at cuts.
2. Install cabinets without distortion so doors and drawers fit openings and are accurately aligned. Adjust hardware to center doors and drawers in openings and to provide unencumbered operation. Complete installation of hardware and accessory items as indicated.
3. Maintain veneer sequence matching of cabinets with transparent finish.

D. Anchor cabinets in accordance with AWI requirements or tested method to anchors or blocking built in or directly attached to framing or substrates.

1. Install cabinets to comply with seismic requirements as indicated on Drawings.

E. Shop Finishes: Touch up finishing after installation of architectural cabinets. Fill nail holes with matching filler.

1. Apply specified finish coats, including stains and paste fillers if any, to exposed surfaces where only sealer/prime coats are shop applied.

a. Use filler matching finish of items being installed.

F. Field Finishing: See Section 099123 "Interior Painting" for finishing of installed architectural cabinets.

3.4 ADJUSTING

A. Repair damaged and defective cabinets, where possible, to eliminate functional and visual defects. Where impossible to repair, replace architectural cabinets. Adjust joinery for uniform appearance.

3.5 CLEANING

A. Clean, lubricate, and adjust hardware and other moving parts to function smoothly.

B. Clean cabinets on exposed and semiexposed surfaces. Touch up finishes to restore damaged or soiled areas.

END OF SECTION 06 41 00

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SECTION 06 64 00 - PLASTIC PANELING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Plastic sheet paneling.

B. Related Requirements:

1. Section 061000 "Rough Carpentry" for wood furring for installing plastic paneling.
2. Section 079200 "Joint Sealants."
3. Section 102600 "Wall and Door Protection."

1.2 ACTION SUBMITTALS

A. Product Data: For each type of specified product.

1. Include material descriptions and tested physical and performance properties of paneling.
2. Include manufacturer's written instructions for evaluating, preparing, and treating substrate.

B. Samples for Initial Selection: Manufacturer's standard color sheets, showing full range of available colors for each type of exposed finish.

1.3 INFORMATIONAL SUBMITTALS

A. Product Certificates: For each type of product.

1.4 QUALITY ASSURANCE

A. Testing Agency: Acceptable to authorities having jurisdiction.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Do not deliver paneling until painting and similar operations that might damage paneling have been completed in installation areas. Store paneling in installation areas or in areas where environmental conditions comply with requirements specified in "Field Conditions" Article.

1.6 FIELD CONDITIONS

A. Environmental Limitations: Do not deliver or install plastic paneling until spaces are enclosed and weathertight and temporary HVAC system is operating and maintaining ambient temperature and humidity conditions at occupancy levels during the remainder of the construction period.

PART 2 - PRODUCTS

2.1 SOURCE LIMITATIONS

A. Obtain plastic paneling and trim accessories from single manufacturer.

2.2 PERFORMANCE REQUIREMENTS

A. Fire-Test-Response Characteristics: As determined by testing identical plastic paneling applied with identical adhesives to substrates in accordance with test method indicated below by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.

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1. Surface-Burning Characteristics: Comply with ASTM E84; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.

    a. Flame-Spread Index: 25 or less.
    b. Smoke-Developed Index: 450 or less.

2.3 PLASTIC SHEET PANELING

A. Glass-Fiber-Reinforced Plastic Paneling: Gelcoat-finished, glass-fiber-reinforced plastic panels complying with ASTM D5319. Panels are to be USDA accepted for incidental food contact.

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. Marlite, Inc.
    b. Nudo; a Verzatec Group Company
    c. Parkland Plastics Inc.; a Patrick Industries Inc. Company
    d. Stabilit America Inc.
    e. Valto Engineered Materials - Formerly Crane Composites, Inc.

2. Nominal Thickness: Not less than 0.12 inch.
3. Surface Finish: As selected by Architect from manufacturer's full range.
4. Color: As selected by Architect from manufacturer's full range.

2.4 ACCESSORIES

A. Trim Accessories: Manufacturer's standard one-piece vinyl extrusions designed to retain and cover edges of panels. Provide division bars, inside corners, outside corners, and caps as needed to conceal edges.

1. Color: As selected by Architect from manufacturer's full range.

B. Exposed Fasteners: Nylon drive rivets recommended by panel manufacturer.

C. Concealed Mounting Splines: Continuous, H-shaped aluminum extrusions designed to fit into grooves routed in edges of factory-laminated panels and to be fastened to substrate.

D. Adhesive: As recommended by plastic paneling manufacturer.

E. Sealant: Mildew-resistant, single-component, neutral-curing silicone sealant recommended by plastic paneling manufacturer and complying with requirements in Section 079200 "Joint Sealants."

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.

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

3.2 PREPARATION

A. Remove wallpaper, vinyl wall covering, loose or soluble paint, and other materials that might interfere with adhesive bond.

B. Prepare substrate by sanding high spots and filling low spots as needed to provide flat, even surface for panel installation.

C. Clean substrates of substances that could impair adhesive bond, including oil, grease, dirt, and dust.

D. Condition panels by unpacking and placing in installation space before installation in accordance with manufacturer's written instructions.

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E. Lay out paneling before installing. Locate panel joints to provide equal panels at ends of walls not less than half the width of full panels.

1. Mark plumb lines on substrate at panel joint locations for accurate installation.
2. Locate trim accessories to allow clearance at panel edges in accordance with manufacturer's written instructions.

3.3 INSTALLATION OF PLASTIC PANELING

A. Install in accordance with manufacturer's written instructions.

B. Install panels in a full spread of adhesive.

C. Install panels with fasteners. Layout fastener locations and mark on face of panels so that fasteners are accurately aligned.

1. Drill oversized fastener holes in panels and center fasteners in holes.
2. Apply sealant to fastener holes before installing fasteners.

D. Install factory-laminated panels using concealed mounting splines in panel joints.

E. Install trim accessories with adhesive. Do not fasten through panels.

F. Fill grooves in trim accessories with sealant before installing panels and bed inside corner trim in a bead of sealant.

G. Maintain uniform space between panels and wall fixtures. Fill space with sealant.

H. Maintain uniform space between adjacent panels and between panels and floors, ceilings, and penetrations. Fill space with sealant.

I. Remove excess sealant and smears as paneling is installed. Clean with solvent recommended by sealant manufacturer and then wipe with clean dry cloths until no residue remains.

END OF SECTION 06 64 00

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SECTION 07 11 13 - BITUMINOUS DAMPPROOFING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Cold-applied, emulsified-asphalt dampproofing.

B. Related Requirements:

1. Section 033000 "Cast-in-Place Concrete" for bituminous vapor retarders under slabs-on-grade.
2. Section 042200 "Concrete Unit Masonry" for mortar parge coat on masonry surfaces.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.

1.3 FIELD CONDITIONS

A. Weather Limitations: Proceed with application only when existing and forecasted weather conditions permit dampproofing to be performed in accordance with to manufacturers' written instructions.

B. Ventilation: Provide adequate ventilation during application of dampproofing in enclosed spaces. Maintain ventilation until dampproofing has cured.

PART 2 - PRODUCTS

2.1 SOURCE LIMITATIONS

A. Obtain primary dampproofing materials and primers from single source from single manufacturer. Provide protection course and auxiliary materials recommended in writing by manufacturer of primary materials.

2.2 PERFORMANCE REQUIREMENTS

A. VOC Content: Products are to comply with VOC content limits of authorities having jurisdiction unless otherwise indicated.

2.3 COLD-APPLIED, EMULSIFIED-ASPHALT DAMPPROOFING

A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1. APOC, Inc; a division of Gardner Industries
2. Brewer Company (The)
3. ChemMasters, Inc
4. Euclid Chemical Company (The); a subsidiary of RPM International, Inc.
5. Henry, a Carlisle Company (formerly Henry Company and Carlisle Coatings & Waterproofing Inc. brands)
6. Karnak Corporation
7. Mar-flex Waterproofing & Building Products
8. W. R. Meadows, Inc

B. Trowel Coats: ASTM D1227/D1227M, Type II, Class 1.

C. Fibered Brush and Spray Coats: ASTM D1227/D1227M, Type II, Class 1.

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D. Brush and Spray Coats: ASTM D1227/D1227M, Type III, Class 1.

2.4 AUXILIARY MATERIALS

A. General: Auxiliary materials recommended in writing by dampproofing manufacturer for intended use and compatible with each other and with bituminous dampproofing.

B. Cut-Back-Asphalt Primer: ASTM D41/D41M.

C. Emulsified-Asphalt Primer: ASTM D1227/D1227M, Type III, Class 1, except diluted with water as recommended in writing by manufacturer.

D. Asphalt-Coated Glass Fabric: ASTM D1668/D1668M, Type I.

E. Patching Compound: Epoxy or latex-modified repair mortar of type recommended in writing by dampproofing manufacturer.

2.5 PROTECTION COURSE

A. Protection Course, Asphaltic: ASTM D6506/D6506M; semirigid sheets of fiberglass or mineral-reinforced-asphaltic core, pressure laminated between two asphalt-saturated fibrous liners.

1. Thickness: Nominal 1/8 inch.
2. Adhesive: Rubber-based solvent type recommended in writing by dampproofing manufacturer for protection course type.

B. Protection Course, Extruded-Polystyrene Board Insulation, Faced: Fan folded, faced on one side with plastic film, nominal thickness **1/4 inch**, with a compressive strength of not less than **8 psi** when tested in accordance with ASTM D1621, and maximum water absorption by volume of 0.6 percent when tested in accordance with ASTM C272/C272M.

C. Protection Course, Extruded-Polystyrene Board Insulation, Unfaced: ASTM C578, Type X, **1/2 inch** thick.

D. Protection Course, Molded-Polystyrene Board Insulation: ASTM C578, Type I, **0.90 lb/cu. ft.** minimum density, **1-inch** minimum thickness.

E. Smooth-surfaced roll roofing complying with ASTM D6380/D6380M, Class S, Type III.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions, with Applicator present, for compliance with requirements for surface smoothness, maximum surface moisture content, and other conditions affecting performance of the Work.

B. Proceed with application only after substrate construction and penetrating work have been completed and unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Clean, prepare, and treat substrates in accordance with dampproofing manufacturer's written application instructions. Provide clean, dust-free, and dry substrates for dampproofing.

B. Mask or otherwise protect adjoining exposed surfaces from being stained, spotted, or coated with dampproofing. Prevent dampproofing materials from entering and clogging weep holes and drains.

C. Clean substrates of projections and substances detrimental to dampproofing work; fill voids, seal joints, and remove bond breakers if any.

D. Apply patching compound to patch and fill tie holes, honeycombs, reveals, and other imperfections .

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3.3 INSTALLATION OF BITUMINOUS DAMPPROOFING, GENERAL

A. Comply with dampproofing manufacturer's written application instructions for cure time between coats and drying time before backfilling unless otherwise indicated.

1. Apply dampproofing to provide continuous plane of protection.
2. Apply additional coats if recommended in writing by manufacturer or to achieve a smooth surface and uninterrupted coverage.

B. Where dampproofing footings and foundation walls, 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.

1. Extend dampproofing **12 inches** onto intersecting walls and footings, but do not extend onto surfaces exposed to view when Project is completed.
2. Install flashings and corner protection stripping at internal and external corners, changes in plane, construction joints, cracks, and where indicated as "reinforced," by embedding an **8-inch-** wide strip of asphalt-coated glass fabric in a heavy coat of dampproofing. Dampproofing coat for embedding fabric is in addition to other coats required.

C. Where dampproofing exterior face of inner wythe of exterior masonry cavity walls, lap dampproofing at least **1/4 inch** onto flashing, masonry reinforcement, veneer ties, and other items that penetrate inner wythe.

1. Extend dampproofing over outer face of structural members and concrete slabs that interrupt inner wythe.
2. Lap dampproofing at least **1/4 inch** onto shelf angles supporting veneer.

D. Where dampproofing interior face of above-grade, exterior walls, continue dampproofing through intersecting walls by keeping vertical mortar joints at intersection temporarily open or by dampproofing wall before constructing intersecting walls.

3.4 INSTALLATION OF COLD-APPLIED, EMULSIFIED-ASPHALT DAMPPROOFING

A. Concrete Foundations and Parged Masonry Foundation Walls: Apply two brush or spray coats at not less than 1.5 gal./100 sq. ft. for first coat and 1 gal./100 sq. ft. for second coat.

B. Unparged Masonry Foundation Walls: Apply primer and two brush or spray coats at not less than 1.5 gal./100 sq. ft. for first coat and 1 gal./100 sq. ft. for second coat.

C. Unexposed Face of Concrete Retaining Walls: Apply one brush or spray coat at not less than **1.25 gal./100 sq. ft.**.

D. Unexposed Face of Masonry Retaining Walls: Apply primer and one brush or spray coat at not less than **1.25 gal./100 sq. ft.**.

E. Concrete Backup for Masonry Veneer Assemblies: Apply one brush or spray coat at not less than **1 gal./100 sq. ft.**.

F. Masonry Backup for Masonry Veneer Assemblies: Apply primer and one brush or spray coat at not less than **1 gal./100 sq. ft.**.

G. Exterior Face of Inner Wythe of Cavity Walls: Apply primer and one brush or spray coat at not less than **1 gal./100 sq. ft.**.

H. Interior Face of Exterior Concrete Walls: Where above grade and indicated to be furred and finished, apply one brush or spray coat at not less than **1 gal./100 sq. ft.**.

I. Interior Face of Exterior Masonry Walls: Where above grade and indicated to be furred and finished, apply primer and one brush or spray coat at not less than **1 gal./100 sq. ft.**.

3.5 INSTALLATION OF PROTECTION COURSE

A. Install protection course over completed-and-cured dampproofing. Comply with dampproofing-material and protection-course manufacturers' written instructions for attaching protection course.

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1. Support protection course over cured coating with spot application of adhesive type recommended in writing by protection-board manufacturer.
2. Install protection course within 24 hours of dampproofing installation (while coating is tacky) to ensure adhesion.

3.6 PROTECTION

A. Protect installed drainage panels from damage due to UV light, harmful weather exposures, physical abuse, and other causes. Provide temporary coverings where panels are subject to abuse and cannot be concealed and protected by permanent construction immediately after installation.

B. Correct dampproofing that does not comply with requirements; repair substrates and reapply dampproofing.

END OF SECTION 07 11 13

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SECTION 07 21 00 - THERMAL INSULATION

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Extruded polystyrene foam-plastic board insulation (XPS).
2. Polyisocyanurate foam-plastic board insulation.
3. Glass-fiber blanket insulation.
4. Mineral-wool blanket insulation.
5. Mineral-wool board insulation.
6. Insulation fasteners.
7. Insulation for miscellaneous voids.
8. Accessories.

B. Related Requirements:

1. Section 042000 "Unit Masonry" for insulation installed in masonry cells.
2. Section 061600 "Sheathing" for foam-plastic board sheathing installed directly over wood or steel framing.
3. Section 072119 "Foamed-in-Place Insulation" for spray-applied polyurethane foam insulation.
4. Section 075423 "Thermoplastic-Polyolefin (TPO) Roofing" for insulation specified as part of roofing system.
5. Section 092900 "Gypsum Board" for sound attenuation blanket used as acoustic insulation.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of specified product.

1.3 INFORMATIONAL SUBMITTALS

A. Installer's Certification: Listing type, manufacturer, and R-value of insulation installed in each element of the building thermal envelope.

1. Sign, date, and post the certification in a conspicuous location on Project site.

B. Product Test Reports: For each product, for tests performed by a qualified testing agency.

C. Research Reports: For extruded polystyrene foam-plastic board insulation (XPS), molded (expanded) polystyrene foam-plastic board insulation (EPS), graphite-polystyrene foam-plastic board insulation (GPS), polyisocyanurate foam-plastic board insulation, from ICC-ES.

1.4 DELIVERY, STORAGE, AND HANDLING

A. Protect insulation materials from physical damage and from deterioration due to 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.

B. Protect foam-plastic board insulation as follows:

1. Do not expose to sunlight except to necessary extent for period of installation and concealment.
2. Protect against ignition at all times. Do not deliver foam-plastic board materials to Project site until just before installation.
3. Quickly complete installation and concealment of foam-plastic board insulation in each area of construction.

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PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Surface-Burning Characteristics: Maximum flame-spread and smoke-developed indexes less than Class A, 25 and 450 when tested in accordance with ASTM E84.

B. Fire-Resistance Ratings: Comply with ASTM E119 or UL 263; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.

1. Indicate design designations from UL's "Fire Resistance Directory" or from listings of another qualified testing agency.

C. Fire Propagation Characteristics: Passes NFPA 285 testing as part of an approved assembly.

D. Labeling: Provide identification of mark indicating R-value of each piece of insulation **12 inches** and wider in width.

E. Thermal-Resistance Value (R-Value): R-value as indicated on Drawings in accordance with ASTM C518.

2.2 EXTRUDED POLYSTYRENE FOAM-PLASTIC BOARD INSULATION (XPS)

A. Extruded Polystyrene Board Insulation, Type X: ASTM C578, Type X, **15 psi** minimum compressive strength; unfaced.

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. Cornerstone Bldg Brands
b. DiversiFoam Products
c. DuPont de Nemours, Inc.
d. Owens Corning
e. The Dow Chemical Company

B. Extruded Polystyrene Board Insulation, Type IV: ASTM C578, Type IV, **25 psi** minimum compressive strength; unfaced.

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

a. DiversiFoam Products
b. DuPont de Nemours, Inc.
c. Kingspan Group
d. Owens Corning
e. The Dow Chemical Company

2.3 POLYISOCYANURATE FOAM-PLASTIC BOARD INSULATION

A. Polyisocyanurate Board Insulation, Foil Faced: ASTM C1289, Type I.

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

a. Atlas Molded Products, a division of Atlas Roofing Corporation
b. Atlas Polyiso Roof and Wall Insulation
c. Carlisle Companies
d. Carlisle Construction Materials; Carlisle Companies
e. DuPont de Nemours, Inc.
f. Elevate; Amrize Building Envelope LLC
g. Hunter Panels; a Carlisle company
h. Johns Manville; a Berkshire Hathaway company
i. Rmax, A Business Unit of Sika Corporation

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2. Class: 2.

B. Polyisocyanurate Board Insulation, Glass-Fiber-Mat Faced: ASTM C1289, Type II, Class 2.

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

a. Atlas Polyiso Roof and Wall Insulation
b. Carlisle Companies
c. Carlisle Construction Materials; Carlisle Companies
d. Elevate; Amrize Building Envelope LLC
e. Hunter Panels; a Carlisle company
f. Johns Manville; a Berkshire Hathaway company
g. Rmax, A Business Unit of Sika Corporation

2.4 GLASS-FIBER BLANKET INSULATION

A. Glass-Fiber Blanket Insulation, Unfaced: ASTM C665, Type I; passing ASTM E136 for combustion characteristics.

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

a. CertainTeed; Saint-Gobain North America
b. Johns Manville; a Berkshire Hathaway company
c. Knauf Insulation
d. Owens Corning

B. Glass-Fiber Blanket Insulation, Foil Faced: ASTM C665, Type III, Class B; Category 1.

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

a. CertainTeed; Saint-Gobain North America
b. Johns Manville; a Berkshire Hathaway company
c. Knauf Insulation
d. Owens Corning

2. Facing: Foil scrim.

2.5 MINERAL-WOOL BLANKET INSULATION

A. Mineral-Wool Blanket Insulation, Unfaced: ASTM C665, Type I; complying with ASTM E136 for combustion characteristics.

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. Johns Manville; a Berkshire Hathaway company
b. Owens Corning
c. Rockwool International A/S

2.6 MINERAL-WOOL BOARD INSULATION

A. Mineral-Wool Board Insulation, Types IA and IB, Unfaced: ASTM C612; passing ASTM E136 for combustion characteristics.

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. Johns Manville; a Berkshire Hathaway company
b. Owens Corning
c. Rockwool International A/S

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2. Nominal Density: 4 lb/cu. ft..
3. Type: IA.

2.7 INSULATION FASTENERS

A. Adhesively Attached, Spindle-Type Anchors: Plate welded to projecting spindle; capable of holding insulation of specified thickness securely in position with self-locking washer in place.

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. AGM Industries, Inc
   b. Gemco

2. Plate: Perforated, galvanized carbon-steel sheet, **0.030 inch** thick by **2 inches** square.
3. Spindle: Copper-coated, low-carbon steel; fully annealed; **0.105 inch** in diameter; length to suit depth of insulation.

B. Insulation-Retaining Washers: Self-locking washers formed from **0.016-inch-** thick galvanized-steel sheet, with beveled edge for increased stiffness, sized as required to hold insulation securely in place, but not less than **1-1/2 inches** square or in diameter.

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. AGM Industries, Inc
   b. Gemco

2. Protect ends with capped self-locking washers incorporating a spring steel insert to ensure permanent retention of cap in ceiling plenums and attic spaces.

C. Anchor Adhesive: Product with demonstrated capability to bond insulation anchors securely to substrates without damaging insulation, fasteners, or substrates.

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. AGM Industries, Inc
   b. Gemco

D. Insulation Fastener Accessories: Provide lagging pins, and other accessory materials that are recommended in writing by insulation fastener manufacturer to produce complete insulation supports.

2.8 INSULATION FOR MISCELLANEOUS VOIDS

A. Glass-Fiber Insulation : ASTM C764, Type II, loose fill; with maximum flame-spread and smoke-developed indexes of 5, in accordance with ASTM E84.

B. Spray-Applied Polyurethane Foam Insulation : ASTM C1029, Type II, closed cell, with maximum flame-spread and smoke-developed indexes of 75 and 450, respectively, in accordance with ASTM E84.

2.9 ACCESSORIES

A. Adhesive for Bonding Insulation : Product compatible with insulation and air and water barrier materials, and with demonstrated capability to bond insulation securely to substrates without damaging insulation and substrates.

B. Eave Ventilation Troughs : Preformed, rigid fiberboard or plastic sheets designed and sized to fit between roof framing members and to provide ventilation between insulated attic spaces and vented eaves.

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PART 3 - EXECUTION

3.1 PREPARATION

A. Clean substrates of substances that are harmful to insulation, including removing projections capable of puncturing insulation or vapor retarders, or those that interfere with insulation attachment.

3.2 INSTALLATION, GENERAL

A. Comply with insulation manufacturer's written instructions applicable to products, applications and applicable codes.

B. Install insulation that is undamaged, dry, and unsoiled and that has not been left exposed to ice, rain, or snow at any time.

C. Install insulation with manufacturer's R-value label exposed after insulation is installed.

D. Extend insulation to envelop entire area to be insulated. Fit tightly around obstructions and fill voids with insulation. Remove projections that interfere with placement.

E. Provide sizes to fit applications and selected from manufacturer's standard thicknesses, widths, and lengths. Apply single layer of insulation units unless multiple layers are otherwise shown or required to make up total thickness or to achieve R-value.

3.3 INSTALLATION OF SLAB INSULATION

A. On vertical slab edge and foundation surfaces, set insulation units using manufacturer's recommended adhesive in accordance with manufacturer's written instructions.

1. If not otherwise indicated, extend insulation a minimum of 24 inches below exterior grade line.

B. On horizontal surfaces, loosely lay insulation units in accordance with manufacturer's written instructions. Stagger end joints and tightly abut insulation units.

1. If not otherwise indicated, extend insulation a minimum of 24 inches in from exterior walls.

3.4 INSTALLATION OF FOUNDATION WALL INSULATION

A. Butt panels together for tight fit.

B. Anchor Installation: Install board insulation on concrete substrates by adhesively attached, spindle-type insulation anchors as follows:

1. Fasten insulation anchors to concrete substrates with insulation anchor adhesive in accordance with anchor manufacturer's written instructions.
2. Space anchors in accordance with insulation manufacturer's written instructions for insulation type, thickness, and application.
3. Apply insulation standoffs to each spindle to create cavity width indicated on Drawings between concrete substrate and insulation.
4. After adhesive has dried, install board insulation by pressing insulation into position over spindles and securing it tightly in place with insulation-retaining washers, taking care not to compress insulation.
5. Where insulation will not be covered by other building materials, apply capped washers to tips of spindles.

C. Adhesive Installation: Install with adhesive or press into tacky waterproofing or dampproofing in accordance with manufacturer's written instructions.

3.5 INSTALLATION OF CAVITY-WALL INSULATION

A. Foam-Plastic Board Insulation: Install pads of adhesive spaced approximately **24 inches** o.c. both ways on inside face and as recommended in writing by manufacturer.

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1. Fit courses of insulation between wall ties and other obstructions, with edges butted tightly in both directions, and with faces flush.
2. Press units firmly against inside substrates.
3. Supplement adhesive attachment of insulation by securing boards with two-piece wall ties designed for this purpose and specified in Section 042000 "Unit Masonry."

B. Mineral-Wool Board Insulation: Install insulation fasteners **4 inches** from each corner of board insulation, at center of board, and as recommended by manufacturer.

1. Fit courses of insulation between masonry wall ties and other obstructions, with edges butted tightly in both directions, and with faces flush.
2. Press units firmly against inside substrates.

3.6 INSTALLATION OF INSULATION IN FRAMED CONSTRUCTION

A. Blanket Insulation: Install in cavities formed by framing members in accordance with the following requirements:

1. Use insulation widths and lengths that fill the cavities formed by framing members. If more than one length is required to fill the cavities, provide lengths that will produce a snug fit between ends.
2. Place insulation in cavities formed by framing members to produce a friction fit between edges of insulation and adjoining framing members.
3. Maintain **3-inch** clearance of insulation around recessed lighting fixtures not rated for or protected from contact with insulation.
4. Attics: Install eave ventilation troughs between roof framing members in insulated attic spaces at vented eaves.
5. For metal-framed wall cavities where cavity heights exceed **96 inches**, support unfaced blankets mechanically and support faced blankets by taping flanges of insulation to flanges of metal studs.
6. Where glass-fiber blankets are indicated for sound attenuation above ceilings, install unfaced blanket insulation over ceiling area in thickness indicated. Where partitions occur, extend insulation up either side of partition.
7. For wood-framed construction, install blankets in accordance with ASTM C1320 and as follows:

   a. With faced blankets having stapling flanges, lap blanket flange over flange of adjacent blanket to maintain continuity of vapor retarder once finish material is installed over it.

8. Vapor-Retarder-Faced Blankets: Tape joints and ruptures in vapor-retarder facings, and seal each continuous area of insulation to ensure airtight installation.

   a. Exterior Walls: Set units with facing placed toward interior of construction.
   b. Interior Walls: Set units with facing placed toward areas of high humidity.

B. Miscellaneous Voids: Install insulation in miscellaneous voids and cavity spaces where required to prevent gaps in insulation using the following materials:

1. Glass-Fiber Insulation: Compact to approximately 40 percent of normal maximum volume equaling a density of approximately **2.5 lb/cu. ft.**.

C. Loose-Fill Insulation: Apply in accordance with ASTM C1015 and manufacturer's written instructions.

1. Level horizontal applications to uniform thickness as indicated, lightly settle to uniform density, but do not compact excessively.
2. For cellulosic-fiber loose-fill insulation, comply with the Cellulose Insulation Manufacturers Association's Technical Bulletin #2, "Standard Practice for Installing Cellulose Building Insulation."

D. Spray-Applied Cellulosic Insulation: Apply spray-applied insulation in accordance with manufacturer's written instructions.

1. Do not apply insulation until installation of pipes, ducts, conduits, wiring, and electrical outlets in walls is completed and windows, electrical boxes, and other items not indicated to receive insulation are masked.

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2. After insulation is applied, make flush with face of studs by using method recommended by insulation manufacturer.

3.7 INSTALLATION OF BOARD INSULATION

A. Install board insulation in accordance with manufacturer's written instructions for Project applications and conditions.

3.8 PROTECTION

A. Protect installed insulation from damage due to harmful weather exposures, physical abuse, and other causes.

B. 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 07 21 00

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SECTION 07 21 19 - FOAMED-IN-PLACE INSULATION

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Closed-cell spray polyurethane foam.

B. Related Requirements:

1. Section 072100 "Thermal Insulation" for foam-plastic board insulation.
2. Section 075700 "Coated Foamed Roofing" for spray polyurethane foam insulation used for roofing applications.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of specified product.

1.3 INFORMATIONAL SUBMITTALS

A. Field Quality Control Reports: For specified tests and inspections.

B. Qualification Statements: For Installer.

1.4 QUALITY ASSURANCE

A. Installer Qualifications: An authorized representative who is trained and approved by manufacturer.

PART 2 - PRODUCTS

2.1 FOAMED-IN-PLACE INSULATION

A. Closed-Cell Spray Polyurethane Foam: ASTM C1029.

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. AMBIT Polyurethane
   b. Barnhardt Manufacturing
   c. Carlisle Construction Materials; Carlisle Companies
   d. Enverge, Amrize Building Envelope LLC
   e. Gaco; Amrize Building Envelope LLC
   f. Henry, a Carlisle Company (formerly Henry Company and Carlisle Coatings & Waterproofing Inc. brands)
   g. Huntsman Building Solutions
   h. Johns Manville; a Berkshire Hathaway company
   i. Quadrant Performance Materials
   j. SWD Urethane Company
   k. Thermoseal USA
   l. Volatile Free, Inc.

2. Type and Minimum Compressive Strength: Type II, minimum density of 1.5 lb/cu. ft. and minimum aged R-value at **1-inch** thickness of **6.2 deg F x h x sq. ft./Btu at 75 deg F**.
3. Surface-Burning Characteristics: Comply with ASTM E84; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.

   a. Flame-Spread Index: 25 or less.
   b. Smoke-Developed Index: 450 or less.

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4. Fire-Propagation Characteristics: Passes NFPA 285 testing as part of an approved assembly.
5. Fire-Safety Barriers: Approved assembly as thermal barrier with accessory components.

PART 3 - EXECUTION

3.1 PREPARATION

A. Verify that substrates are clean, dry, and free of substances that are harmful to insulation.

B. Priming: Prime substrates where recommended by insulation manufacturer. Apply primer to comply with insulation manufacturer's written instructions. Confine primers to areas to be insulated; do not allow spillage or migration onto adjoining surfaces.

3.2 INSTALLATION OF FOAMED-IN-PLACE INSULATION

A. Comply with insulation manufacturer's written instructions applicable to products and applications.

B. Spray insulation to envelop entire area to be insulated and fill voids.

C. Apply in multiple passes to not exceed maximum thicknesses recommended by manufacturer. Do not spray into rising foam.

D. Framed Construction: Install into cavities formed by framing members to achieve thickness indicated on Drawings.

E. Cavity Walls: Install into cavities to fully fill void.

F. Miscellaneous Voids: Apply in accordance with manufacturer's written instructions.

G. Install thermal barrier material.

1. Do not cover insulation prior to any required spray foam insulation inspections.

H. Apply barrier coatings in accordance with manufacturer's written instructions and to comply with requirements for listing and labeling for fire-propagation characteristics and surface-burning characteristics specified.

1. Use equipment and techniques best suited for substrate and type of material applied as recommended by coating manufacturer.
2. Apply coatings to prepared surfaces as soon as practical after preparation and before subsequent surface soiling or deterioration.
3. Apply coatings to produce surface films without cloudiness, spotting, holidays, laps, brush marks, roller tracking, runs, sags, ropiness, or other surface imperfections. Produce sharp lines and color breaks.

3.3 FIELD QUALITY CONTROL

A. Manufacturer's Field Service: Engage a factory-authorized service representative to test and inspect spray foam insulation installation, including accessories. Report results in writing.

3.4 PROTECTION

A. Protect installed insulation from damage due to harmful weather exposures, physical abuse, and other causes.

END OF SECTION 07 21 19

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SECTION 07 24 19 - WATER-DRAINAGE EXTERIOR INSULATION AND FINISH SYSTEM (EIFS)

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes: Water-drainage exterior insulation and finish system (EIFS).

1. EIFS-clad drainage-wall assemblies that are field applied over substrate.
2. Water-resistive barrier coatings.

B. Related Requirements:

1. Section 072500 "Weather Barriers" for water-resistant building paper or building wrap and flexible flashings installed over sheathing behind mechanically fastened EIFS.
2. Section 072600 "Vapor Retarders" for wall sheet vapor retarders.
3. Section 072726 "Fluid-Applied Membrane Air Barriers" for fluid-applied, synthetic polymer air barriers applied over sheathing behind EIFS-clad wall assemblies.

1.2 DEFINITIONS

A. Definitions in ASTM E2110 apply to Work of this Section.

B. EIFS: Exterior insulation and finish system(s).

C. IBC: International Building Code.

1.3 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1.4 ACTION SUBMITTALS

A. Product Data: For each specified system and assembly, including components and accessories.

1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes.

B. Shop Drawings:

1. Include details for EIFS buildouts.
2. Include details for parapet cap flashing.

C. Samples: For each exposed product and for each color and texture specified, 8 inches square in size.

1.5 INFORMATIONAL SUBMITTALS

A. Qualification Statements: For Installer.

B. Manufacturer Certificates: Signed by EIFS manufacturer, certifying the following:

1. EIFS complies with requirements.
2. Substrates to which EIFS is indicated to be attached are acceptable to EIFS manufacturer.
3. Accessory products installed with EIFS, including joint sealants, flashing, water-resistive barrier coatings, trim, whether or not furnished by EIFS manufacturer and whether or not specified in this Section, are acceptable to EIFS manufacturer.

C. Product Certificates: For insulation and joint sealant, from manufacturer.

D. Product Test Reports: For each EIFS assembly and component, and for water-resistive barrier

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coatings, for tests performed by a qualified testing agency.

E. Field Quality Control Reports: For specified tests and inspections.

F. Sample Warranties: For specified special warranties.

1.6 CLOSEOUT SUBMITTALS

A. Maintenance Data: For EIFS.

1.7 QUALITY ASSURANCE

A. Installer Qualifications: An installer who is certified in writing by AWCI International as qualified to install Class PB EIFS using trained workers.

1.8 MOCKUPS

A. Build mockups to verify selections made under Sample submittals, to demonstrate aesthetic effects, to set quality standards for materials and execution, and to set quality standards for fabrication and installation.

1. Build mockup of typical wall area as indicated on Drawings.
2. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Owner specifically approves such deviations by Change Order.
3. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.9 DELIVERY, STORAGE, AND HANDLING

A. Deliver materials in original, unopened packages with manufacturers' labels intact and clearly identifying products.

B. Store materials inside and under cover; keep them dry and protected from weather, direct sunlight, surface contamination, aging, corrosion, damaging temperatures, construction traffic, and other causes.

1. Stack insulation board flat and off the ground.
2. Protect plastic insulation against ignition at all times. Do not deliver plastic insulating materials to Project site before installation time.
3. Complete installation and concealment of plastic materials as rapidly as possible in each area of construction.

1.10 FIELD CONDITIONS

A. Weather Limitations: Proceed with installation only when existing and forecasted weather conditions and ambient outdoor air, humidity, and substrate temperatures permit EIFS to be applied, dried, and cured according to manufacturers' written instructions and warranty requirements.

1. Proceed with installation of adhesives or coatings only when ambient temperatures have remained, or are forecast to remain, above **40 deg F** for a minimum of 24 hours before, during, and after application. Do not apply EIFS adhesives or coatings during rainfall.

1.11 WARRANTY

A. Manufacturer's Special Warranty: Manufacturer agrees to repair or replace components of EIFS-clad drainage-wall assemblies that fail in materials or workmanship within specified warranty period.

1. Failures include, but are not limited to, the following:

a. Bond integrity and weathertightness.
b. Deterioration of EIFS finishes and other EIFS materials beyond normal weathering.

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2. Warranty coverage includes the following components of EIFS-clad drainage-wall assemblies:

    a. EIFS finish, including base coats, finish coats, and reinforcing mesh.
    b. Insulation installed as part of EIFS including foam buildouts.
    c. Insulation adhesive and mechanical fasteners.
    d. EIFS accessories, including trim components and flashing.
    e. Water-resistive barrier coatings.
    f. EIFS drainage components.

3. Warranty Period: Five years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. EIFS Performance: Comply with ASTM E2568 and with the following:

1. Weathertightness: Resistant to uncontrolled water penetration from exterior, with a means to drain water entering EIFS to the exterior.
2. System Fire Performance: Fire-resistance rating of wall assembly.
3. Structural Performance of Assembly and Components:

    a. Wind Loads:

        1) Uniform pressure of <**Insert lbf/sq. ft.**>, acting inward or outward.
        2) Uniform pressure as indicated on Drawings.

4. Impact Performance: ASTM E2568, Medium impact resistance unless otherwise indicated.
5. Abrasion Resistance of Finish Coat: Sample consisting of **1-inch-** thick EIFS mounted on **1/2-inch-** thick gypsum board; cured for a minimum of 28 days and shows no cracking, checking, or loss of film integrity after exposure to **528 quarts** of sand when tested in accordance with ASTM D968, Method A.
6. Mildew Resistance of Finish Coat: Sample applied to **2-by-2-inch** clean glass substrate; cured for 28 days and shows no growth when tested in accordance with ASTM D3273 and evaluated in accordance with ASTM D3274.
7. Drainage Efficiency: 90 percent average minimum when tested in accordance with ASTM E2273.

2.2 WATER-DRAINAGE EXTERIOR INSULATION AND FINISH SYSTEM (EIFS)

A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1. Corev America, Inc
2. Dryvit, part of Tremco CPG
3. Finestone, a Sika brand
4. Greenmaker Industries
5. H.B. Fuller Construction Products Inc. / TEC
6. Master Wall Inc.
7. Omega Products International
8. Parex, a Sika brand
9. Pleko Systems International
10. Senergy; a SIKA brand
11. Sika Corporation
12. Sto Corp.
13. Stuc-O-Flex International, Inc.
14. Total Wall, Inc.

B. Source Limitations: Obtain EIFS from single source from single EIFS manufacturer and from sources approved by EIFS manufacturer as compatible with EIFS components.

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2.3 EIFS MATERIALS

A. Water-Resistive Barrier Coating: EIFS manufacturer's standard formulation and accessories for use as water-resistive barrier coating; compatible with substrate.

1. Water-Resistance: Comply with physical and performance criteria of ASTM E2570/E2570M.

B. Flexible-Membrane Flashing: Cold-applied, self-adhering, self-healing, rubberized-asphalt, and polyethylene-film composite sheet or tape and primer; EIFS manufacturer's standard or product recommended in writing by EIFS manufacturer.

C. Insulation Adhesive: EIFS manufacturer's standard formulation designed for indicated use; specifically formulated to be applied to back side of insulation in a manner that creates open vertical channels designed to serve as an integral part of the water-drainage system of the EIFS-clad drainage-wall assembly; compatible with substrate; and complying with one of the following:

1. Job-mixed formulation of portland cement complying with ASTM C150/C150M, Type I, and polymer-based adhesive specified for base coat.
2. Factory-blended dry formulation of portland cement, dry polymer admixture, and fillers specified for base coat.
3. Factory-mixed noncementitious formulation designed for adhesive attachment of insulation to substrates of type indicated, as recommended by EIFS manufacturer.

D. Molded, (Expanded) Rigid Cellular Polystyrene Board Insulation: Comply with ASTM E2430/E2430M, unless otherwise noted, and the following:

1. Flame-Spread and Smoke-Developed Indexes: 25 and 450 or less, respectively, in accordance with ASTM E84.
2. Dimensions: Provide insulation boards of not more than **24 by 48 inches**, with thickness indicated on Drawings.
3. Channeled Board Insulation: EIFS manufacturer's standard factory-fabricated profile with linear, vertical-drainage channels, slots, or waves on the back side of board.
4. Foam Buildouts: Provide with profiles and dimensions indicated on Drawings.

E. Reinforcing Mesh: Balanced, alkali-resistant, open-weave, glass-fiber mesh treated for compatibility with other EIFS materials, made from continuous multiend strands with retained mesh tensile strength of not less than **120 lbf/in.** in accordance with ASTM E2098/E2098M and the following:

1. Reinforcing Mesh for EIFS, General: Not less than weight required to comply with impact-performance level specified in "Performance Requirements" Article.
2. Strip-Reinforcing Mesh: Not less than As recommended by EIFS manufacturer.
3. Detail-Reinforcing Mesh: Not less than As recommended by EIFS manufacturer.
4. Corner-Reinforcing Mesh: Not less than As recommended by EIFS manufacturer.

F. Base Coat: EIFS manufacturer's standard mixture complying with one of the following:

1. Job-mixed formulation of portland cement complying with ASTM C150/C150M, Type I, white or natural color; and manufacturer's standard polymer-emulsion adhesive designed for use with portland cement.
2. Job-combined formulation of manufacturer's standard polymer-emulsion adhesive and manufacturer's standard dry mix containing portland cement.
3. Factory-blended dry formulation of portland cement, dry polymer admixture, and inert fillers to which only water is added at Project site.
4. Factory-mixed noncementitious formulation of polymer-emulsion adhesive and inert fillers that is ready to use without adding other materials.

G. Water-Resistant Base Coat: EIFS manufacturer's standard water-resistant formulation complying with one of the following:

1. Job-mixed formulation of portland cement complying with ASTM C150/C150M, Type I, white or natural color; and manufacturer's standard polymer-emulsion adhesive designed for use with portland cement.
2. Job-combined formulation of manufacturer's standard polymer-emulsion adhesive and manufacturer's standard dry mix containing portland cement.

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H. Mechanical Fasteners: EIFS manufacturer's standard corrosion-resistant fasteners, consisting of thermal cap, standard washer and shaft attachments, and fastener indicated below; designed to resist Project's design loads; capable of pulling fastener head below surface of insulation board; and complying with the following:

1. For attachment to steel studs from **0.033 to 0.112 inch** in thickness, provide steel drill screws complying with ASTM C954.
2. For attachment to light-gauge steel framing members not less than **0.0179 inch** in thickness, provide steel drill screws complying with ASTM C1002.
3. For attachment to wood framing members and plywood sheathing, provide steel drill screws complying with ASTM C1002, Type W.
4. For attachment to masonry and concrete substrates, provide sheathing dowel in form of a plastic wing-tipped fastener with thermal cap, sized to fit insulation thickness indicated and to penetrate substrate to depth required to secure anchorage.
5. For attachment to substrate, provide manufacturer's standard fasteners suitable for substrate.

I. Primer: EIFS manufacturer's standard factory-mixed, elastomeric-polymer primer for preparing base-coat surface for application of finish coat.

J. Finish Coat: EIFS manufacturer's standard acrylic-based coating with enhanced mildew resistance complying with the following:

1. Factory-mixed formulation of polymer-emulsion binder, colorfast mineral pigments, sound stone particles, and fillers.
2. Factory-mixed formulation of polymer-emulsion binder, colorfast mineral pigments, and fillers used with stone particles for embedding in finish coat to produce an applied-aggregate finish.
3. Colors: As indicated by manufacturer's designations or As selected by Architect from manufacturer's full range.
4. Textures: As indicated by manufacturer's designations or As selected by Architect from manufacturer's full range.

K. Sealer: Manufacturer's waterproof, clear acrylic-based sealer for protecting finish coat.

L. Water: Potable.

M. Trim Accessories: Type as designated or required to suit conditions indicated and to comply with EIFS manufacturer's written instructions; manufactured from UV-stabilized PVC; and complying with ASTM D1784, manufacturer's standard cell class for use intended, and ASTM C1063.

1. Casing Bead: Prefabricated, one-piece type for attachment behind insulation, of depth required to suit thickness of coating and insulation, with face leg perforated for bonding to coating and back leg.
2. Drip Screed/Track: Prefabricated, one-piece type for attachment behind insulation with face leg extended to form a drip, of depth required to suit thickness of coating and insulation, with face leg perforated for bonding to coating and back leg.
3. Weep Screed/Track: Prefabricated, one-piece type for attachment behind insulation with perforated face leg extended to form a drip and weep holes in track bottom, of depth required to suit thickness of coating and insulation, with face leg perforated for bonding to coating and back leg; designed to drain incidental moisture that gets into wall construction to the exterior at terminations of EIFS with drainage.
4. Expansion Joint: Closed-cell polyethylene backer rod and elastomeric sealant **3/4-inch-** minimum.
5. Windowsill Flashing: Prefabricated type for both flashing and sloping sill over framing beneath windows; with end and back dams; designed to direct water to exterior.
6. Parapet Cap Flashing: Type for both flashing and covering parapet top, with design complying with ASTM C1397 and ANSI/SPRI/FM 4435/ES-1.

2.4 MIXING

A. Comply with EIFS manufacturer's requirements for combining and mixing materials. Do not introduce admixtures, water, or other materials, except as recommended by EIFS manufacturer. Mix materials in clean containers. Use materials within time period specified by EIFS manufacturer or discard.

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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 roof edges, wall framing, flashings, openings, substrates, and junctures at other construction for suitable conditions where EIFS will be installed.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

1. Begin coating application only after surfaces are dry.
2. Application of coating indicates acceptance of surfaces and conditions.

3.2 PREPARATION

A. Protect contiguous work from moisture deterioration and soiling caused by application of EIFS. Provide temporary covering and other protection needed to prevent spattering of exterior finish coats on other work.

B. Protect EIFS, substrates, and wall construction behind them from inclement weather during installation. Prevent penetration of moisture behind drainage plane of EIFS and deterioration of substrates.

C. Prepare and clean substrates to comply with EIFS manufacturer's written instructions to obtain optimum bond between substrate and adhesive for insulation.

1. Concrete Substrates: Provide clean, dry, neutral-pH substrate for insulation installation. Verify suitability of substrate by performing bond and moisture tests recommended by EIFS manufacturer.

3.3 INSTALLATION OF EIFS, GENERAL

A. Comply with ASTM C1397, ASTM E2511, and EIFS manufacturer's written instructions for installation of EIFS as applicable to each type of substrate indicated.

3.4 APPLICATION OF SUBSTRATE PROTECTION

A. Water-Resistive Barrier Coating: Apply over sheathing to provide a water-resistive barrier.

1. Tape and seal joints, exposed edges, terminations, and inside and outside corners of sheathing unless otherwise indicated by EIFS manufacturer's written instructions.

B. Flexible-Membrane Flashing: Install over water-resistive barrier coating, applied and lapped to shed water; seal at openings, penetrations, and terminations. Prime substrates with flashing primer if required and install flashing.

3.5 INSTALLATION OF TRIM

A. Trim: Apply trim accessories at perimeter of EIFS, at expansion joints, at windowsills, and elsewhere as indicated. Coordinate with installation of insulation.

1. Weep Screed/Track: Use at bottom termination edges, at window and door heads , and at floor line expansion joints of water-drainage EIFS unless otherwise indicated.
2. Windowsill Flashing: Use at windows unless otherwise indicated.
3. Expansion Joint: Use where indicated on Drawings.
4. Casing Bead: Use at other locations.
5. Parapet Cap Flashing: Use where indicated on Drawings.
6. <**Insert trim and requirements**>.

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3.6 INSTALLATION OF INSULATION

A. Board Insulation: Adhesively and mechanically attach insulation to substrate in compliance with ASTM C1397 and the following:

1. Apply adhesive to insulation by notched-trowel method, with notches oriented vertically to produce drainage channels that remain functional after the insulation is adhered to substrate.
2. Apply adhesive to insulation by notched-trowel method in a manner that results in coating the entire surface of drainage mat with adhesive once insulation is adhered to drainage mat.
3. Apply adhesive to ridges on back of channeled insulation by notched-trowel method in a manner that results in full adhesive contact over the entire surface of ridges, leaving channels free of adhesive once insulation is adhered to substrate.
4. Press and slide insulation into place. Apply pressure over entire surface of insulation to accomplish uniform contact, high initial grab, and overall level surface.
5. Allow adhered insulation to remain undisturbed for not less than 24 hours, before installing mechanical fasteners, beginning rasping and sanding insulation or applying base coat and reinforcing mesh.
6. Mechanically attach insulation to substrate. Install top surface of fastener heads flush with plane of insulation. Install fasteners into or through substrates with the following minimum penetration:

    a. Steel Framing: **5/16 inch**.
    b. Wood Framing: **1 inch**.
    c. Concrete and Masonry: **1 inch**.

7. Apply insulation over substrates in courses with long edges of boards oriented horizontally.
8. Begin first course of insulation from a level base line and work upward.
9. Begin first course of insulation from screed/track and work upward. Work from perimeter casing beads toward interior of panels if possible.
10. Stagger vertical joints of insulation boards in successive courses to produce running bond pattern. Locate joints, so no piece of insulation is less than **12 inches** wide or **6 inches** high. Offset joints not less than **6 inches** from corners of window and door openings and not less than 4 inches from aesthetic reveals.

    a. Adhesive Attachment: Offset joints of insulation not less than **6 inches** from horizontal and **4 inches** from vertical joints in sheathing.
    b. Mechanical Attachment: Offset joints of insulation from horizontal joints in sheathing.

11. Apply channeled insulation, with drainage channels aligned vertically.
12. Interlock ends at internal and external corners.
13. Abut insulation tightly at joints within and between each course to produce flush, continuously even surfaces without gaps or raised edges between boards. If gaps greater than **1/16 inch** occur, fill with insulation cut to fit gaps exactly; insert insulation without using adhesive or other material.
14. Cut insulation to fit openings, corners, and projections precisely and to produce edges and shapes complying with details indicated.
15. Rasp or sand flush entire surface of insulation to remove irregularities projecting more than 1/32 inch from surface of insulation and to remove yellowed areas due to sun exposure; do not create depressions deeper than **1/16 inch**. Prevent airborne dispersal and immediately collect insulation raspings or sandings.
16. Cut aesthetic reveals in outside face of insulation with high-speed router and bit configured to produce grooves, rabbets, and other features that comply with profiles and locations indicated. Do not reduce insulation thickness at aesthetic reveals to less than **3/4 inch**.
17. Install foam buildouts and attach to structural substrate by adhesive and mechanical fastening.
18. Interrupt insulation for expansion joints where indicated.
19. Form joints for sealant application by leaving gaps between adjoining insulation edges and between insulation edges and dissimilar adjoining surfaces. Make gaps wide enough to produce joint widths indicated after encapsulating joint substrates with base coat and reinforcing mesh.
20. Form joints for sealant application with back-to-back casing beads for joints within EIFS and with perimeter casing beads at dissimilar adjoining surfaces. Make gaps between casing beads and between perimeter casing beads and adjoining surfaces of width indicated.
21. Before installing insulation and before applying field-applied reinforcing mesh, fully wrap board

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edges. Cover edges of board and extend encapsulating mesh not less than **2-1/2 inches** over front and back face unless otherwise indicated on Drawings.

22. Treat exposed edges of insulation as follows:

    a. Except for edges forming substrates of sealant joints, encapsulate with base coat, reinforcing mesh, and finish coat.
    b. Encapsulate edges forming substrates of sealant joints within EIFS or between EIFS and other work with base coat and reinforcing mesh.
    c. At edges trimmed by accessories, extend base coat, reinforcing mesh, and finish coat over face leg of accessories.

23. Coordinate installation of flashing and insulation to produce wall assembly that does not allow water to penetrate behind flashing and water-resistive barrier coating.

B. Expansion Joints: Install at locations indicated, where required by EIFS manufacturer, and as follows:

1. At expansion joints in substrates behind EIFS.
2. Where EIFS adjoin dissimilar substrates, materials, and construction, including other EIFS.
3. At floor lines in multilevel wood-framed construction.
4. Where wall height or building shape changes.
5. Where EIFS manufacturer requires joints in long continuous elevations.

3.7 APPLICATION OF BASE COAT

A. Water-Resistant Base Coat: Apply full-thickness coverage to exposed insulation and to exposed surfaces of foam build-outs and to other surfaces indicated on Drawings.

B. Base Coat: Apply full coverage to exposed insulation and foam build-outs with not less than 1/16-inch dry-coat thickness.

C. Reinforcing Mesh: Embed reinforcing mesh in wet base coat to produce wrinkle-free installation with mesh continuous at corners, overlapped not less than **2-1/2 inches** or otherwise treated at joints to comply with ASTM C1397. Do not lap reinforcing mesh within **8 inches** of corners. Completely embed mesh, applying additional base-coat material if necessary, so reinforcing-mesh color and pattern are invisible.

D. Double-Layer Reinforcing-Mesh Application: Where indicated or required, apply second base coat and second layer of reinforcing mesh, overlapped not less than **2-1/2 inches** or otherwise treated at joints to comply with ASTM C1397 in same manner as first application. Do not apply until first base coat has cured.

E. Additional Reinforcing Mesh: Apply strip-reinforcing mesh around openings, extending **4 inches** beyond perimeter. Apply additional **9-by-12-inch** strip-reinforcing mesh diagonally at corners of openings (re-entrant corners). Apply **8-inch-** wide, strip-reinforcing mesh at both inside and outside corners unless base layer of mesh is lapped not less than **4 inches** on each side of corners.

1. At aesthetic reveals, apply strip-reinforcing mesh not less than **8 inches** wide.
2. Embed strip-reinforcing mesh in base coat before applying first layer of reinforcing mesh.

F. Foam Buildouts: Fully embed reinforcing mesh in base coat.

G. Double Base-Coat Application: Where indicated, apply second base coat in same manner and thickness as first application, except without reinforcing mesh. Do not apply until first base coat has cured.

3.8 APPLICATION OF FINISH COAT

A. Primer: Apply over dry base coat.

B. Finish Coat: Apply full-thickness coverage over dry primed base coat, maintaining a wet edge at all times for uniform appearance, to produce a uniform finish of color and texture matching approved sample and free of cold joints, shadow lines, and texture variations.

1. Embed aggregate in finish coat to produce a uniform applied-aggregate finish of color and

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texture matching approved sample.

C. Sealer Coat: Apply over dry finish coat, in number of coats and thickness required by EIFS manufacturer.

3.9 FIELD QUALITY CONTROL

A. Special Inspections: Owner will engage a qualified special inspector to perform the following special inspections:

1. Water-resistive barrier coatings applied over sheathing.

B. Testing Agency: Owner will engage a qualified testing agency to perform tests and inspections.

C. EIFS Tests and Inspections: In accordance with ASTM E2359/E2359M ..

D. EIFS will be considered defective if it does not pass tests and inspections.

E. Prepare test and inspection reports.

3.10 CLEANING

A. Remove temporary covering and protection of other work. Promptly remove coating materials from window and door frames and other surfaces outside areas indicated to receive EIFS coatings.

END OF SECTION 07 24 19

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SECTION 07 25 00 - WEATHER BARRIERS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Weather barrier types.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of specified product.

B. Shop Drawings: Show details of weather barrier at terminations, openings, and penetrations. Show details of flexible flashing applications.

1.3 INFORMATIONAL SUBMITTALS

A. Material Test Reports: For weather barrier, by a qualified testing agency.

B. Product Test Reports: For weather barrier, for tests performed by a qualified testing agency.

C. Research Reports: For weather barrier, from ICC-ES showing compliance with IBC code requirements.

D. Evaluation Reports: Report Type: Water-resistive barrier and flexible flashing, from ICC-ES.

E. Qualification Statements: For Installer.

1.4 QUALITY ASSURANCE

A. Installer Qualifications: Entity that employs installers and supervisors who are trained and approved by manufacturer.

1.5 MOCKUPS

A. Build mockups to set quality standards for materials and execution.

1. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Owner specifically approves such deviations by Change Order.
2. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Deliver weather barrier materials to Project site in original containers with seals unbroken and labeled with manufacturer's name, product brand name and type, date of manufacture, approval or listing agency markings, and directions for storing and mixing with other components.

1.7 FIELD CONDITIONS

A. Weather Limitations: Proceed with installation only when existing and forecasted weather conditions permit weather barrier materials to be installed in accordance with manufacturer's written installation instructions and warranty requirements.

1.8 WARRANTY

A. Warranty Period: 15 years from date of Substantial Completion.

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PART 2 - PRODUCTS

2.1 WEATHER BARRIER TYPES

A. Building Wrap: Flame-spread and smoke-developed indexes of less than 25 and 450, respectively, when tested in accordance with ASTM E84; UV stabilized; and acceptable to authorities having jurisdiction.

1. Basis-of-Design Product: Subject to compliance with requirements, provide Tyvek CommercialWrap D by DuPont or comparable product by one of the following:

   a. Alpha ProTech
   b. Barricade Building Products
   c. Benjamin Obdyke Incorporated
   d. Dorken Systems Inc.
   e. DuPont de Nemours, Inc.
   f. Kingspan Group
   g. PrimeSource Building Products, Inc.
   h. Typar; a Magnera Corporation brand

2. Building Wrap Materials: Type I, ASTM E2556/E2556M.
3. Composition Type: Polypropylene woven fabric with coating.
4. Water-Vapor Permeance: Minimum 20 perms in accordance with ASTM E96/E96M, Desiccant Method (Procedure A).
5. Air Permeance: Not more than 0.004 cfm/sq. ft. at 1.57 lbf/sq. ft. when tested in accordance with ASTM E2178.
6. Allowable UV Exposure Time: Not more than 180 days.
7. Flame Propagation Test: Materials and construction to be as tested in accordance with NFPA 285.

2.2 ACCESSORY MATERIALS

A. Requirement: Provide primers, fasteners, seam tapes, flashing, transition strips, termination strips, joint sealants, counterflashing strips, flashing sheets and metal termination bars, termination mastic, substrate patching materials, adhesives, tapes, foam sealants, lap sealants, and other accessory materials that are recommended in writing by weather barrier manufacturer to produce a complete weather barrier assembly and that are compatible with primary weather barrier material and adjacent construction to which they may seal.

2.3 Flashing Tape

A. Basis-of-Design Product: Subject to compliance with requirements, provide DuPont de Nemours, Inc.: DuPont Flashing Tape or comparable product by one of the following:

B. Material

1. Material: Acrylic Butyl Rubber

PART 3 - EXECUTION

3.1 INSTALLATION OF WEATHER BARRIERS

A. Weather Barriers:

1. Building Wrap: Comply with manufacturer's written instructions and warranty requirements.

B. Install weather barrier accessories for a complete installation with weather barriers in accordance with manufacturer's written instructions.

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3.2 FIELD QUALITY CONTROL

A. Testing Agency: Owner will engage a qualified third-party testing agency to perform tests and inspections.

1. Coordinate with testing agency and factory-authorized service representative to observe mockup test-wall areas and periodic site visit of 30 percent and 75 percent for product system installation reviews in accordance with manufacturer's instructions.
2. Do not cover weather barriers until final acceptance.
3. Provide field reports and include any inconsistencies from manufacturer's instructions.

3.3 CLEANING

A. Immediately remove release paper and other discarded materials from Project site and legally dispose of them.

3.4 PROTECTION

A. Protect installed weather barrier from the following:

1. Damage from cladding, structure, or a component of the structure (for example, window, door, or wall system).
2. Contamination from building site chemicals, premature deterioration of building materials, or nonstandard use or application of products.
3. Foreign objects or agents, including the use of materials incompatible with weather barrier products.
4. UV exposure in excess of products' stated limits.

END OF SECTION 07 25 00

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SECTION 07 26 00 - VAPOR RETARDERS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Polyethylene vapor retarders.

B. Related Requirements:

1. Section 033000 "Cast-in-Place Concrete" for under-slab vapor retarders.
2. Section 072100 "Thermal Insulation" for vapor retarders integral with insulation products.

1.2 ACTION SUBMITTALS

A. Product Data:

1. Polyethylene vapor retarders.
2. Reinforced-polyethylene vapor retarders.
3. Fire-retardant, reinforced-polyethylene vapor retarders.

1.3 INFORMATIONAL SUBMITTALS

A. Product Test Reports: For each product, for tests performed by a qualified testing agency.

PART 2 - PRODUCTS

2.1 POLYETHYLENE VAPOR RETARDERS

A. Polyethylene Vapor Retarders: ASTM D4397, 10-mil- thick sheet, with maximum permeance rating of **0.1 perm**.

2.2 ACCESSORIES

A. Vapor-Retarder Tape: Pressure-sensitive tape of type recommended by vapor-retarder manufacturer for sealing joints and penetrations in vapor retarder.

B. Adhesive for Vapor Retarders: Product recommended by vapor-retarder manufacturer and has demonstrated capability to bond vapor retarders securely to substrates indicated.

C. Vapor-Retarder Fasteners: Pancake-head, self-tapping steel drill screws; with fender washers.

PART 3 - EXECUTION

3.1 PREPARATION

A. Clean substrates of substances that are harmful to vapor retarders, including removing projections capable of puncturing vapor retarders.

3.2 INSTALLATION OF VAPOR RETARDERS ON FRAMING

A. Place vapor retarders on side of construction indicated on Drawings.

B. Extend vapor retarders to extremities of areas to protect from vapor transmission. Secure vapor retarders in place with adhesives, vapor retarder fasteners, or other anchorage system as recommended by manufacturer. Extend vapor retarders to cover miscellaneous voids in insulated substrates, including those filled with loose-fiber insulation.

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C. Seal vertical joints in vapor retarders over framing by lapping no fewer than two studs and sealing with vapor-retarder tape according to vapor-retarder manufacturer's written instructions. Locate all joints over framing members or other solid substrates.

D. Seal joints caused by pipes, conduits, electrical boxes, and similar items penetrating vapor retarders with vapor-retarder tape to create an airtight seal between penetrating objects and vapor retarders.

E. Repair tears or punctures in vapor retarders immediately before concealment by other work. Cover with vapor-retarder tape or another layer of vapor retarders.

3.3 INSTALLATION OF VAPOR RETARDERS IN CRAWL SPACES

A. Install vapor retarders over prepared grade. Lap joints a minimum of **12 inches** and seal with manufacturer's recommended tape. Install second layer over pathways to equipment.

B. Extend vapor retarder over footings and seal to foundation wall or grade beam with manufacturer's recommended tape.

1. Extend vapor retarder vertically minimum 24 inches above top of footing.

C. Seal around penetrations such as utilities and columns in order to create a monolithic, airtight membrane at grade surface, perimeter, and all vertical penetrations.

3.4 PROTECTION

A. Protect vapor retarders from damage until concealed by permanent construction.

END OF SECTION 07 26 00

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SECTION 07 27 26 - FLUID-APPLIED MEMBRANE AIR BARRIERS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. High-build air barriers, vapor permeable.

B. Related Requirements:

1. Section 061600 "Sheathing" for wall sheathings and wall sheathing joint-and-penetration treatments.
2. Section 072500 "Weather Barriers" for weather barriers, including building wraps with air-barrier properties.

1.2 DEFINITIONS

A. Air-Barrier Accessory: A transitional component of the air barrier that provides continuity.

B. Air-Barrier Assembly: The collection of air-barrier materials and accessories applied to an opaque wall, including joints and junctions to abutting construction, to control air movement through the wall.

C. Air-Barrier Material: A primary element that provides a continuous barrier to the movement of air.

1.3 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1. Review air-barrier requirements and installation, special details, mockups, air-leakage and bond testing, air-barrier protection, and work scheduling that covers air barriers.

1.4 ACTION SUBMITTALS

A. Product Data: Include manufacturer's written instructions for evaluating, preparing, and treating each substrate; technical data; dry film thickness; and tested physical and performance properties of products.

1. High-build air barriers, vapor retarding.
2. High-build air barriers, vapor permeable.
3. Medium-build air barriers, vapor retarding.
4. Medium-build air barriers, vapor permeable.
5. Low-build air barriers, vapor retarding.
6. Low-build air barriers, vapor permeable.

B. Shop Drawings: For air-barrier assemblies.

1. Show locations and extent of air-barrier materials, accessories, and assemblies specific to Project conditions.
2. Include details for substrate joints and cracks, counterflashing strips, penetrations, inside and outside corners, terminations, and tie-ins with adjoining construction.
3. Include details of interfaces with other materials that form part of air barrier.

1.5 INFORMATIONAL SUBMITTALS

A. Qualification Data: For Installer. Include list of ABAA-certified installers and supervisors employed by Installer, who work on Project.

B. Product Certificates: From air-barrier manufacturer, certifying compatibility of air barriers and

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accessory materials with Project materials that connect to or that come in contact with the barrier.

C. Product Test Reports: For each air-barrier assembly, for tests performed by a qualified testing agency.

D. Field quality-control reports.

1.6 QUALITY ASSURANCE

A. Installer Qualifications: An entity that employs installers and supervisors who are trained and approved by manufacturer.

1. Installer to be licensed by ABAA in accordance with ABAA's Quality Assurance Program and to employ ABAA-certified installers and supervisors on Project.

B. Mockups: Build mockups to set quality standards for materials and execution .

1. Build integrated mockups of exterior wall assembly , 150 sq. ft., incorporating backup wall construction, external cladding, window, storefront, door frame and sill, insulation, ties and other penetrations, and flashing to demonstrate surface preparation, crack and joint treatment, application of air barriers, and sealing of gaps, terminations, and penetrations of air-barrier assembly.

   a. Coordinate construction of mockups to permit inspection and testing of air barrier before external insulation and cladding are installed.
   b. Include junction with roofing membrane , building corner condition, and foundation wall intersection.
   c. If Architect determines mockups do not comply with requirements, reconstruct mockups and apply air barrier until mockups are approved.

2. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Architect specifically approves such deviations in writing.
3. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Remove and replace liquid materials that cannot be applied within their stated shelf life.

B. Protect stored materials from direct sunlight.

1.8 FIELD CONDITIONS

A. Environmental Limitations: Apply air barrier within the range of ambient and substrate temperatures recommended in writing by air-barrier manufacturer.

1. Protect substrates from environmental conditions that affect air-barrier performance.
2. Do not apply air barrier to a damp or wet substrate or during snow, rain, fog, or mist.

PART 2 - PRODUCTS

2.1 SOURCE LIMITATIONS

A. Obtain primary air-barrier materials and air-barrier accessories from single manufacturer.

2.2 PERFORMANCE REQUIREMENTS

A. Air-Barrier Performance: Air-barrier assembly and seals with adjacent construction to be capable of performing as a continuous air barrier and as a liquid-water drainage plane flashed to discharge to the exterior incidental condensation or water penetration. Air-barrier assemblies to be capable of accommodating substrate movement and of sealing substrate expansion and control joints, construction material changes, penetrations , tie-ins to installed waterproofing, and transitions at perimeter conditions without deterioration and air leakage exceeding specified limits.

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B. Air-Barrier Assembly Air Leakage: Maximum 0.04 cfm/sq. ft. of surface area at 1.57 lbf/sq. ft., when tested in accordance with ASTM E2357.

C. Air Permeance: Maximum 0.004 cfm/sq. ft. of surface area at 1.57 lbf/sq. ft. pressure difference; ASTM E2178.

D. Ultimate Elongation: Minimum 250 percent; ASTM D412, Die C.

E. Adhesion to Substrate: Minimum 16 lbf/sq. in. when tested in accordance with ASTM D4541.

F. Fire Propagation Characteristics: Passes NFPA 285 testing as part of an approved assembly.

G. UV Resistance: Can be exposed to sunlight for 180 days in accordance with manufacturer's written instructions.

2.3 HIGH-BUILD AIR BARRIERS, VAPOR PERMEABLE

A. High-Build, Vapor-Permeable Air Barrier, Synthetic Polymer Type: Synthetic polymer membrane with an installed dry film thickness, according to manufacturer's written instructions, of **35 mils** or thicker over smooth, void-free substrates.

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. DuPont de Nemours, Inc.
   b. GCP Applied Technologies Inc.
   c. Henry, a Carlisle Company (formerly Henry Company and Carlisle Coatings & Waterproofing Inc. brands)
   d. Sto Corp.
   e. Tremco Incorporated

B. Vapor Permeance: Minimum 5 perms; ASTM E96/E96M, Procedure A, Desiccant Method.

2.4 ACCESSORY MATERIALS

A. Provide primers, transition strips, termination strips, joint reinforcing fabric and strips, joint sealants, counterflashing strips, flashing sheets and metal termination bars, termination mastic, substrate patching materials, adhesives, tapes, foam sealants, lap sealants, and other accessory materials that are recommended in writing by air-barrier manufacturer to produce a complete air-barrier assembly and that are compatible with primary air-barrier material and adjacent construction to which they may seal.

B. Primer: Liquid waterborne primer recommended for substrate by air-barrier material manufacturer.

C. Stainless Steel Sheet: ASTM A240/A240M, Type 304, 0.0187 inch thick, and Series 300 stainless steel fasteners.

D. Preformed Silicone Extrusion: Manufacturer's standard system consisting of cured low-modulus silicone extrusion, sized to fit opening widths, with a single-component, neutral-curing, Class 100/50 (low-modulus) silicone sealant for bonding extrusions to substrates.

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. GE Construction Sealants; Momentive Performance Materials Inc.
   b. Pecora Corporation
   c. PROSOCO, Inc
   d. The Dow Chemical Company
   e. Tremco Incorporated

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PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements and other conditions affecting performance of the Work.

1. Verify that substrates are sound and free of oil, grease, dirt, excess mortar, or other contaminants.
2. Verify that substrates have cured and aged for minimum time recommended in writing by air-barrier manufacturer.
3. Verify that substrates are visibly dry and free of moisture. Test concrete substrates for capillary moisture by plastic sheet method in accordance with ASTM D4263.
4. Verify that masonry joints are flush and completely filled with mortar.

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

3.2 SURFACE PREPARATION

A. Clean, prepare, treat, fill, and seal substrate and joints and cracks in substrate in accordance with manufacturer's written instructions and details. Provide clean, dust-free, and dry substrate for air-barrier application.

B. Mask off adjoining surfaces not covered by air barrier to prevent spillage and overspray affecting other construction.

C. Remove grease, oil, bitumen, form-release agents, paints, curing compounds, and other penetrating contaminants or film-forming coatings from concrete.

D. Remove fins, ridges, mortar, and other projections and fill honeycomb, aggregate pockets, holes, and other voids in concrete with substrate-patching material.

E. Remove excess mortar from masonry ties, shelf angles, and other obstructions.

F. At changes in substrate plane, apply sealant or termination mastic beads at sharp corners and edges to form a smooth transition from one plane to another.

G. Cover gaps in substrate plane and form a smooth transition from one substrate plane to another with stainless steel sheet mechanically fastened to structural framing to provide continuous support for air barrier.

H. Bridge expansion joints and discontinuous wall-to-wall, deck-to-wall, and deck-to-deck joints with air-barrier accessory material that accommodates joint movement in accordance with manufacturer's written instructions and details.

3.3 INSTALLATION OF ACCESSORIES

A. Install accessory materials in accordance with air-barrier manufacturer's written instructions and details to form a seal with adjacent construction and ensure continuity of air and water barrier.

1. Coordinate the installation of air barrier with installation of roofing membrane and base flashing to ensure continuity of air barrier with roofing membrane.
2. Install transition strip on roofing membrane or base flashing so that a minimum of **3 inches** of coverage is achieved over each substrate.
3. Unless manufacturer recommends in writing against priming, apply primer to substrates at required rate and allow it to dry.
4. Apply primer to substrates at required rate and allow it to dry. Limit priming to areas that will be covered by air-barrier material on same day. Reprime areas exposed for more than 24 hours.

B. Connect and seal exterior wall air-barrier material continuously to roofing-membrane air barrier, concrete below-grade structures, floor-to-floor construction, exterior glazing and window systems, glazed curtain-wall systems, storefront systems, exterior louvers, exterior door framing, and other construction used in exterior wall openings, using accessory materials.

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C. At end of each working day, seal top edge of strips and transition strips to substrate with termination mastic.

D. Apply joint sealants forming part of air-barrier assembly within manufacturer's recommended application temperature ranges. Consult manufacturer when sealant cannot be applied within these temperature ranges.

E. Wall Openings: Prime concealed, perimeter frame surfaces of windows, curtain walls, storefronts, and doors. Apply preformed silicone extrusion so that a minimum of **3 inches** of coverage is achieved over each substrate. Maintain **3 inches** of full contact over firm bearing to perimeter frames, with not less than **1 inch** of full contact.

1. Transition Strip: Roll firmly to enhance adhesion.
2. Preformed Silicone Extrusion: Set in full bed of silicone sealant applied to walls, frame, and air-barrier material.

F. Fill gaps in perimeter frame surfaces of windows, curtain walls, storefronts, and doors, and miscellaneous penetrations of air-barrier material with foam sealant.

G. Seal strips and transition strips around masonry reinforcing or ties and penetrations with termination mastic.

H. Seal top of through-wall flashings to air barrier with an additional **6-inch-** wide, transition strip.

I. Seal exposed edges of strips at seams, cuts, penetrations, and terminations not concealed by metal counterflashings or ending in reglets with termination mastic.

J. Repair punctures, voids, and deficient lapped seams in strips and transition strips. Slit and flatten fishmouths and blisters. Patch with transition strips extending **6 inches** beyond repaired areas in strip direction.

3.4 INSTALLATION OF PRIMARY AIR-BARRIER MATERIAL

A. Apply air-barrier material to form a seal with strips and transition strips and to achieve a continuous air barrier in accordance with air-barrier manufacturer's written instructions and details. Apply air-barrier material within manufacturer's recommended application temperature ranges.

1. Unless manufacturer recommends in writing against priming, apply primer to substrates at required rate and allow it to dry.
2. Limit priming to areas that will be covered by air-barrier material on same day. Reprime areas exposed for more than 24 hours.
3. Where multiple prime coats are needed to achieve required bond, allow adequate drying time between coats.

B. High-Build Air Barriers: Apply continuous unbroken air-barrier material to substrates according to the following thickness. Apply air-barrier material in full contact around protrusions such as masonry ties.

1. Vapor-Retarding, High-Build Air Barrier: Total dry film thickness as recommended in writing by manufacturer to comply with performance requirements, but not less than 35 mils, applied in two equal coats.
2. Vapor-Permeable, High-Build Air Barrier: Total dry film thickness as recommended in writing by manufacturer to comply with performance requirements, but not less than 35 mils, applied in two equal coats.

C. Do not cover air barrier until it has been tested and inspected by testing agency.

D. Correct deficiencies in or remove air barrier that does not comply with requirements; repair substrates and reapply air-barrier components.

3.5 FIELD QUALITY CONTROL

A. ABAA Quality Assurance Program: Perform examinations, preparation, installation, testing, and inspections under ABAA's Quality Assurance Program.

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B. Testing Agency: Owner will engage a qualified testing agency to perform tests and inspections.

C. Inspections: Air-barrier materials, accessories, and installation are subject to inspection for compliance with requirements. Inspections may include the following:

1. Continuity of air-barrier system has been achieved throughout the building envelope with no gaps or holes.
2. Air-barrier dry film thickness.
3. Continuous structural support of air-barrier system has been provided.
4. Masonry and concrete surfaces are smooth, clean, and free of cavities, protrusions, and mortar droppings.
5. Site conditions for application temperature and dryness of substrates have been maintained.
6. Maximum exposure time of materials to UV deterioration has not been exceeded.
7. Surfaces have been primed, if applicable.
8. Laps in strips and transition strips have complied with minimum requirements and have been shingled in the correct direction (or mastic has been applied on exposed edges), with no fishmouths.
9. Termination mastic has been applied on cut edges.
10. Strips and transition strips have been firmly adhered to substrate.
11. Compatible materials have been used.
12. Transitions at changes in direction and structural support at gaps have been provided.
13. Connections between assemblies (air-barrier and sealants) have complied with requirements for cleanliness, surface preparation and priming, structural support, integrity, and continuity of seal.
14. All penetrations have been sealed.

D. Tests: As determined by testing agency from among the following tests:

1. Air-Leakage-Location Testing: Air-barrier assemblies will be tested for evidence of air leakage in accordance with ASTM E1186, chamber pressurization or depressurization with smoke tracers.
2. Air-Leakage-Volume Testing: Air-barrier assemblies will be tested for air-leakage rate in accordance with ASTM E783 or.
3. Adhesion Testing: Air-barrier assemblies will be tested for required adhesion to substrate in accordance with ASTM D4541 for each 600 sq. ft. of installed air barrier or part thereof.

E. Air barriers will be considered defective if they do not pass tests and inspections.

1. Apply additional air-barrier material, in accordance with manufacturer's written instructions, where inspection results indicate insufficient thickness.
2. Remove and replace deficient air-barrier components for retesting as specified above.

F. Repair damage to air barriers caused by testing; follow manufacturer's written instructions.

G. Prepare test and inspection reports.

3.6 CLEANING AND PROTECTION

A. Protect air-barrier system from damage during application and remainder of construction period, in accordance with manufacturer's written instructions.

1. Protect air barrier from exposure to UV light and harmful weather exposure as recommended in writing by manufacturer. If exposed to these conditions for longer than recommended, remove and replace air barrier or install additional, full-thickness, air-barrier application after repairing and preparing the overexposed materials in accordance with air-barrier manufacturer's written instructions.
2. Protect air barrier from contact with incompatible materials and sealants not approved by air-barrier manufacturer.

B. Clean spills, stains, and soiling from construction that would be exposed in the completed work using cleaning agents and procedures recommended in writing by manufacturer of affected construction.

C. Remove masking materials after installation.

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END OF SECTION 07 27 26

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SECTION 07 31 13 - ASPHALT SHINGLES

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Glass-fiber-reinforced asphalt shingles.
2. Underlayment materials.
3. Ridge vents.
4. Sheet metal flashing and trim.

B. Related Requirements:

1. Section 077200 "Roof Accessories" for roof ventilators.

1.2 DEFINITIONS

A. Roofing Terminology: See ASTM D1079 for definitions of terms related to roofing Work in this Section.

1.3 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of specified product.

B. Shop Drawings: For sheet metal flashing and trim.

C. Samples for Initial Selection:

1. For each type of asphalt shingle indicated.
2. For each type of accessory involving color selection.

D. Samples for Verification: For the following products, in sizes indicated:

1. Asphalt Shingles: Full size.
2. Ridge and Hip Cap Shingles: Full size.
3. Ridge Vent: **12-inch-** long Sample.
4. Exposed Valley Lining: **12 inches** square.

1.5 INFORMATIONAL SUBMITTALS

A. Product Test Reports: For each type of asphalt shingle and underlayment product indicated, for tests performed by a qualified testing agency.

B. Research Reports: For synthetic underlayment, from ICC-ES, indicating that product is suitable for intended use under applicable building codes.

C. Qualification Statements: For roofing system Installer.

D. Sample Warranties: For specified warranties.

1.6 CLOSEOUT SUBMITTALS

A. Maintenance Data: For asphalt shingles.

B. Warranty Documentation:

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1. Manufacturer's material warranty.
2. Roofing system installer's warranty.

1.7 MAINTENANCE MATERIAL SUBMITTALS

A. Extra Stock Material: Furnish extra materials, from the same production run, that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Asphalt Shingles: 100 sq. ft. of each type and in each color and blend, in unbroken bundles.

1.8 QUALITY ASSURANCE

A. Roofing System Installer Qualifications: Entity that employs a supervisor who is an NRCA ProCertified Roofing Foreman or installers who are NRCA ProCertified asphalt shingle system installers.

1.9 MOCKUPS

A. Build mockups to verify selections made under Sample submittals, to demonstrate aesthetic effects, and to set quality standards for materials and execution.

1. Build mockups of asphalt shingles, including related roofing materials.

a. Size: 48 inches long by 96 inches wide.
b. Include gutter and downspout complying with requirements in Section 077100 "Roof Specialties."

2. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Owner specifically approves such deviations by Change Order.
3. Approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.10 DELIVERY, STORAGE, AND HANDLING

A. Store roofing materials in a dry, well-ventilated location protected from weather, sunlight, and moisture in accordance with manufacturer's written instructions.

B. Store underlayment rolls on end, on pallets or other raised surfaces. Do not double-stack rolls.

C. Protect unused roofing materials from weather, sunlight, and moisture when left overnight or when roofing Work is not in progress.

D. Handle, store, and place roofing materials in a manner to prevent damage to roof deck or structural supporting members.

1.11 FIELD CONDITIONS

A. Environmental Limitations: Proceed with installation only when existing and forecasted weather conditions permit product installation and related Work to be performed in accordance with manufacturer's written instructions and warranty requirements.

1. Install self-adhering, polymer-modified bitumen sheet underlayment within the range of ambient and substrate temperatures recommended in writing by manufacturer.

1.12 WARRANTY

A. Manufacturer's Materials Warranty: Manufacturer agrees to repair or replace asphalt shingles that fail within specified warranty period.

1. Failures include, but are not limited to, the following:

a. Manufacturing defects.

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2. Materials Warranty Period: 25 years from date of Substantial Completion, prorated, with first three years nonprorated.
3. Wind-Speed Warranty Period: Asphalt shingles will resist blow-off or damage caused by wind speeds of up to 110 mph for five years from date of Substantial Completion.
4. Algae-Resistance Warranty Period: Asphalt shingles will not discolor for 20 years from date of Substantial Completion.
5. Workmanship Warranty Period: Two years from date of Substantial Completion.

B. Roofing System Installer's Warranty: On warranty form at end of this Section, signed by Installer, in which Installer agrees to repair or replace components of asphalt shingle roofing that fail in materials or workmanship within specified warranty period.

1. Warranty Period: Two years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 SOURCE LIMITATIONS

A. Obtain each type of product from single source from single manufacturer.

2.2 PERFORMANCE REQUIREMENTS

A. Exterior Fire-Test Exposure: Provide asphalt shingles and related roofing materials identical to those of assemblies tested for Class A fire resistance in accordance with ASTM E108 or UL 790 by Underwriters Laboratories or another testing and inspecting agency acceptable to authorities having jurisdiction. Identify products with appropriate markings of applicable testing agency.

B. Wind Resistance: Provide asphalt shingles that comply with requirements of ASTM D3161/D3161M, Class F, and with ASTM D7158/D7158M, Class H.

2.3 GLASS-FIBER-REINFORCED ASPHALT SHINGLES

A. Three-Tab-Strip Asphalt Shingles: ASTM D3462/D3462M; glass-fiber reinforced, mineral-granule surfaced, and self-sealing; with tabs regularly spaced.

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

a. Atlas Molded Products, a division of Atlas Roofing Corporation
b. Building Products of Canada Corp.
c. CertainTeed; Saint-Gobain North America
d. GAF Materials Corporation
e. IKO Industries Inc.
f. Malarkey Roofing Products
g. Owens Corning
h. PABCO Roofing Products
i. Tamko Building Products LLC

2. Strip Size: Manufacturer's standard.
3. Algae Resistance: Granules resist algae discoloration.
4. Color and Blends: As selected by Architect from manufacturer's full range.

2.4 UNDERLAYMENT MATERIALS

A. Synthetic Underlayment: UV-resistant polypropylene, polyolefin, or polyethylene polymer fabric with surface coatings or treatments to improve traction underfoot and abrasion resistance; evaluated and documented to be suitable for use as a roof underlayment under applicable codes by a testing and inspecting agency acceptable to authorities having jurisdiction.

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:

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a. ALCO Products LLC
b. Atlas Polyiso Roof and Wall Insulation
c. Building Products of Canada Corp.
d. CertainTeed; Saint-Gobain North America
e. Drexel Metals Corp. – Carlisle Construction Materials
f. G.A.P. Roofing, Inc.
g. GAF Materials Corporation
h. GCP Applied Technologies Inc.
i. IKO Industries Inc.
j. Malarkey Roofing Products
k. Owens Corning
l. PrimeSource Building Products, Inc.
m. SDP Advanced Polymer Products Inc.
n. SystemComponents Corporation
o. Tamko Building Products LLC

2.5 RIDGE VENTS

A. Rigid Ridge Vent: Manufacturer's standard, rigid-section, high-density, UV-stabilized plastic ridge vent for use under ridge shingles.

1. Basis-of-Design Product: Subject to compliance with requirements, provide GAF Cobra Rigid Vent 3 or comparable product by one of the following:

a. Air Vent, Inc.; Gibraltar Industries, Inc.
b. Benjamin Obdyke Incorporated
c. CertainTeed; Saint-Gobain North America
d. Cor-A-Vent, Inc
e. GAF Materials Corporation
f. Lomanco, Inc
g. Owens Corning
h. Tamko Building Products LLC
i. Tapco International Corporation; Mid-America Components

2. Features:

a. Nonwoven geotextile filter strips.
b. External deflector baffles.

2.6 SHEET METAL FLASHING AND TRIM

A. Comply with requirements in Section 076200 "Sheet Metal Flashing and Trim."

1. Sheet Metal: Aluminum, mill finished.

B. 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 the item unless otherwise specified in this Section or indicated on Drawings.

1. Apron Flashings: Fabricate with lower flange a minimum of 4 inches over and 4 inches beyond each side of downslope asphalt shingles and 6 inches up the vertical surface.
2. Step Flashings: Fabricate with a headlap of **2 inches** and a minimum extension of 4 inches over the underlying asphalt shingle and up the vertical surface.
3. Cricket and Backer Flashings: Fabricate with concealed flange extending a minimum of 18 inches beneath upslope asphalt shingles and 6 inches beyond each side of skylight and 6 inches above the roof plane.
4. Counterflashings: Fabricate to cover 4 inches of base flashing measured vertically; and in lengths required so that no step exceeds 8 inches and overall length is no more than 10 feet.

a. Provide metal reglets for installation.

5. Open-Valley Flashings: Fabricate from metal sheet not less than 24 inches wide in lengths not exceeding 10 feet, with 1-inch- high, inverted-V profile water diverter at center of valley and

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equal flange widths of not less than 11 inches.

a. Hem flange edges for fastening with metal cleats.
b. Add stiffening ribs in flashings to promote drainage.

6. Drip Edges: Fabricate in lengths not exceeding 10 feet with minimum **2-inch** roof-deck flange and **1-1/2-inch** fascia flange with **3/8-inch** drip at lower edge.
7. Vent-Pipe Flashings: ASTM B749, Type L51121, at least **1/16 inch** thick. Provide lead sleeve sized to slip over and turn down into pipe, soldered to skirt at slope of roof, and extending at least **4 inches** from pipe onto roof.

2.7 ACCESSORIES

A. Asphalt Roofing Cement: ASTM D4586/D4586M Type II, asbestos free.

B. Elastomeric Flashing Sealant: ASTM C920, Type S, Grade NS, one-part, non-sag, elastomeric polymer sealant; of class and use classifications required to seal joints and remain watertight; recommended in writing by manufacturer for installation of flashing systems.

C. Roofing Nails: ASTM F1667, aluminum, stainless steel, copper, or hot-dip galvanized-steel wire shingle nails, minimum **0.120-inch-** diameter, sharp-pointed, with a **3/8- to 7/16-inch-** diameter flat head and of sufficient length to penetrate **3/4 inch** into solid wood decking or extend at least **1/8 inch** through sheathing less than **3/4 inch** thick.

1. Where nails are in contact with metal flashing, use nails made from same metal as flashing.

D. Underlayment Nails: Aluminum, stainless steel, or hot-dip galvanized-steel wire nails with low-profile metal or plastic caps, **1-inch-** minimum diameter.

1. Provide with minimum **0.0134-inch-** thick metal cap, **0.010-inch-** thick power-driven metal cap, or **0.035-inch-** thick plastic cap; and with minimum **0.083-inch-** thick ring shank or **0.091-inch-** thick smooth shank of length to penetrate at least **3/4 inch** into roof sheathing or to penetrate through roof sheathing less than **3/4 inch** thick.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions, with roofing system Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.

1. Examine roof sheathing to verify that sheathing joints are supported by framing and blocking or metal clips and that installation is within flatness tolerances.
2. Verify that substrate is sound, dry, smooth, clean, sloped for drainage, and completely anchored and that provisions have been made for flashings and penetrations through asphalt shingles.
3. Verify that vent stacks and other penetrations through roofing are installed and securely fastened.

B. Prepare written report, endorsed by roofing system Installer, listing conditions detrimental to performance of the Work.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION OF UNDERLAYMENT MATERIALS

A. Comply with asphalt shingle and underlayment manufacturers' written installation instructions and with recommendations in NRCA's "The NRCA Roofing Manual: Steep-Slope Roof Systems" applicable to products and applications indicated unless more stringent requirements are specified in this Section or indicated on Drawings.

B. Synthetic Underlayment:

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1. Install on roof deck parallel with and starting at the eaves.

    a. Lap sides and ends as recommended in writing by manufacturer, but not less than 4 inches for side laps and **6 inches** for end laps.
    b. Stagger end laps between succeeding courses at interval recommended in writing by manufacturer, but not less than **72 inches**.
    c. Fasten with underlayment nails in accordance with manufacturer's written instructions.
    d. Cover underlayment within period recommended in writing by manufacturer.

2. Install in single layer on roofs sloped at 4:12 and greater.
3. Install in double layer on roofs sloped at less than 4:12.
4. Install synthetic underlayment on roof deck not covered by self-adhering, polymer-modified bitumen sheet unless otherwise specified in this Section or indicated on Drawings.

    a. Lap sides of underlayment over self-adhering sheet not less than **4 inches** in direction to shed water.
    b. Lap ends of underlayment not less than **6 inches** over self-adhering sheet.

5. Install fasteners in a grid pattern of **12 inches** between side laps with **6-inch** spacing at side and end laps.
6. Terminate synthetic underlayment extended up not less than 4 inches against sidewalls, curbs, chimneys, and other roof projections.

C. Metal-Flashed, Open-Valley Underlayment: Install two layers of minimum **36-inch-** wide underlayment centered in valley.

1. Use same underlayment as installed on field of roof.
2. Stagger end laps between layers at least **72 inches**.
3. Lap ends of each layer at least **12 inches** in direction that sheds water, and seal with asphalt roofing cement.
4. Fasten each layer to roof deck with underlayment nails located as far from valley center as possible and only to extent necessary to hold underlayment in place until installation of valley flashing.
5. Lap roof-deck underlayment over first layer of valley underlayment at least **6 inches**.

3.3 INSTALLATION OF SHEET METAL FLASHING AND TRIM

A. Install metal flashings and trim to comply with requirements in Section 076200 "Sheet Metal Flashing and Trim."

1. Install metal flashings in accordance with recommendations in NRCA's "NRCA Guidelines for Asphalt Shingle Roof Systems."
2. Bed flanges of metal flashings using asphalt roofing cement or elastomeric flashing sealant.

B. Apron Flashings: Extend lower flange over and beyond each side of downslope asphalt shingles and up the vertical surface.

C. Step Flashings: Install with a headlap of **2 inches** and extend over underlying shingle and up the vertical face.

1. Install with lower edge of flashing just upslope of, and concealed by, butt of overlying shingle.
2. Fasten to roof deck only.

D. Cricket and Backer Flashings: Install against roof-penetrating elements extending concealed flange beneath upslope asphalt shingles and beyond each side.

E. Counterflashings: Coordinate with installation of base flashing and fit tightly to base flashing. Lap joints a minimum of **4 inches** secured in a waterproof manner.

1. Install in reglets or receivers.

F. Open-Valley Flashings: Install centered in valleys, lapping ends at least 8 inches in direction that sheds water. Fasten upper end of each length to roof deck beneath overlap.

1. Secure hemmed flange edges into metal cleats spaced 12 inches apart and fastened to roof

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deck.

2. Adhere minimum 9-inch- wide strips of self-adhering, polymer-modified bitumen sheet to metal flanges and to underlying self-adhering sheet, polymer-modified bitumen sheet.

    a. Place strips parallel to and over flanges so that they will be just concealed by installed shingles.

3. Provide a closure at the end of the inverted-V profile of the valley metal to minimize water and ice infiltration.

G. Rake Drip Edges: Install over underlayment materials and fasten to roof deck.

H. Eave Drip Edges: Install below underlayment materials and fasten to roof deck.

I. Pipe Flashings: Form flashing around pipe penetrations and asphalt shingles. Fasten and seal to asphalt shingles as recommended by manufacturer.

3.4 INSTALLATION OF GLASS-FIBER-REINFORCED ASPHALT SHINGLES

A. Install asphalt shingles in accordance with manufacturer's written instructions and recommendations in NRCA's "NRCA Guidelines for Asphalt Shingle Roof Systems."

B. Install starter strip along lowest roof edge, consisting of an asphalt shingle strip at least 7 inches wide with self-sealing strip face up at roof edge.

1. Extend asphalt shingles 1/2 inch over fasciae at eaves and rakes.
2. Install starter strip along rake edge.

C. Install first and remaining courses of laminated asphalt shingles stair-stepping diagonally across roof deck with manufacturer's recommended offset pattern at succeeding courses, maintaining uniform exposure.

D. Install first and remaining courses of three-tab-strip asphalt shingles stair-stepping diagonally across roof deck with manufacturer's recommended offset pattern at succeeding courses, maintaining uniform exposure.

E. Fasten asphalt shingle strips with a minimum of four roofing nails, but not less than the number indicated in manufacturer's written instructions for roof slope and design wind speed indicated on Drawings and for warranty requirements specified in this Section.

1. Locate fasteners in accordance with manufacturer's written instructions.
2. Where roof slope exceeds 18:12, hand seal self-sealing asphalt shingles to improve the shingles' positive bond by applying asphalt roofing cement spots between course overlaps after nailing the upper course.
3. Where roof slope is less than 4:12, hand seal self-sealing asphalt shingles to improve the shingles' positive bond by applying asphalt roofing cement spots between course overlaps after nailing the upper course.
4. When ambient temperature during installation is below 50 deg F, hand seal self-sealing asphalt shingles by applying asphalt roofing cement spots between course overlaps after nailing the upper course.

F. Woven Valleys: Extend succeeding asphalt shingle courses from both sides of valley 12 inches beyond center of valley, weaving intersecting shingle-strip courses over each other. Use one-piece shingle strips without joints in valley.

1. Do not nail asphalt shingles within **6 inches** of valley center.

G. Closed-Cut Valleys: Extend asphalt shingle strips from one side of valley 12 inches beyond center of valley.

1. Use one-piece shingle strips without joints in valley.
2. Fasten with extra nail in upper end of shingle. Install asphalt shingle courses from other side of valley and cut back to a straight line **2 inches** short of valley centerline.
3. Trim upper concealed corners of cut-back shingle strips.
4. Do not nail asphalt shingles within **6 inches** of valley center.

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5. Set trimmed, concealed-corner asphalt shingles in a **3-inch-** wide bed of asphalt roofing cement.

H. Open Valleys: Cut and fit asphalt shingles at open valleys, trimming upper concealed corners of shingle strips.

1. Maintain uniform width of exposed open valley from highest to lowest point.
2. Extend shingle a minimum of **4 inches** over valley metal.
3. Set valley edge of asphalt shingles in a **3-inch-** wide bed of asphalt roofing cement.
4. Do not nail asphalt shingles to metal open-valley flashings.

I. Ridge Vents: Install continuous ridge vents over asphalt shingles in accordance with manufacturer's written instructions. Fasten with roofing nails of sufficient length to penetrate sheathing.

3.5 ROOFING SYSTEM INSTALLER'S WARRANTY

A. WHEREAS _____ of _____, herein called the "Roofing System Installer," has performed roofing and associated Work on the following Project:

1. Owner: <**Insert name of Owner**>.
2. Owner Address: <**Insert address**>.
3. Building Name/Type: <**Insert information**>.
4. Building Address: <**Insert address**>.
5. Area of the Work: <**Insert information**>.
6. Warranty Period: Two years from date of Substantial Completion.
7. Date of Substantial Completion: _____.

B. AND WHEREAS Roofing System Installer has contracted (either directly with Owner or indirectly as a subcontractor) to warrant said Work against leaks and faulty or defective materials and workmanship for designated Warranty Period,

C. NOW THEREFORE Roofing System Installer hereby warrants, subject to terms and conditions herein set forth, that during Warranty Period, Roofing System, Installer will, at Roofing System Installer's own cost and expense, make or cause to be made such repairs to or replacements of said Work as are necessary to correct faulty and defective work and as are necessary to maintain said Work in a watertight condition.

D. This Warranty is made subject to the following terms and conditions:

1. Specifically excluded from this Warranty are damages to the Work and other parts of the building, and to building contents, caused by:

   a. lightning;
   b. peak gust wind speed exceeding <**Insert mph**>;
   c. fire;
   d. failure of roofing system substrate, including cracking, settlement, excessive deflection, deterioration, and decomposition;
   e. faulty construction of copings, chimneys, skylights, vents, equipment supports, and other edge conditions and penetrations of the Work;
   f. vapor condensation on bottom of roofing; and
   g. activity on roofing by others, including construction contractors, maintenance personnel, other persons, and animals, whether authorized or unauthorized by Owner.

2. When the Work has been damaged by any of foregoing causes, Warranty becomes null and void until such damage has been repaired by Roofing System Installer and until cost and expense thereof have been paid by Owner or by another responsible party so designated.
3. Roofing System Installer is responsible for damage to the Work covered by this Warranty but is not liable for consequential damages to building or building contents resulting from leaks or faults or defects of the Work.
4. During Warranty Period, if Owner allows alteration of the Work by anyone other than Roofing System Installer, including cutting, patching, and maintenance in connection with penetrations, attachment of other work, and positioning of anything on roof, this Warranty becomes null and void on date of the alterations, but only to the extent the alterations affect the Work covered by this Warranty. If Owner engages Roofing System Installer to perform the alterations, Warranty

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does not become null and void unless Roofing System Installer, before starting the alterations, has notified Owner in writing, showing reasonable cause for claim, that said alterations would likely damage or deteriorate the Work, thereby reasonably justifying a limitation or termination of this Warranty.

5. During Warranty Period, if original use of roof is changed and it becomes used for, but was not originally specified for, a use or service more severe than originally specified, this Warranty becomes null and void on date of the change, but only to the extent the change affects the Work covered by this Warranty.
6. Owner to promptly notify Roofing System Installer of observed, known, or suspected leaks, defects, or deterioration and afford reasonable opportunity for Roofing System Installer to inspect the Work and to examine evidence of such leaks, defects, or deterioration.
7. This Warranty is recognized to be the only warranty of Roofing System Installer on said Work and does not operate to restrict or cut off Owner from other remedies and resources lawfully available to Owner in cases of roofing failure. Specifically, this Warranty does not operate to relieve Roofing System Installer of responsibility for performance of the Work in accordance with requirements of the Contract Documents, regardless of whether Contract was a contract directly with Owner or a subcontract with Owner's General Contractor.

E. IN WITNESS THEREOF, this instrument has been duly executed this _____ day of _____, _____.

1. Authorized Signature: _____.
2. Name: _____.
3. Title: _____.

END OF SECTION 07 31 13

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SECTION 07 42 93 - SOFFIT PANELS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Metal soffit panels.

B. Related Requirements:

1. Section 074213.13 "Formed Metal Wall Panels" for metal wall panels.

1.2 COORDINATION

A. Coordinate installation of soffit panels and support system with insulation, weather barriers, air barriers, flashings, and other adjoining construction to ensure proper sequencing.

1.3 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of specified product.

B. Shop Drawings:

1. Include 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.
2. Accessories: Include details of flashing, trim, and anchorage systems, at a scale of not less than **1-1/2 inches per 12 inches**.

C. Samples for Initial Selection: Manufacturer's standard color charts, showing full range of available colors for each type of exposed finish.

1. Include similar Samples of trim and accessories involving color selection.

D. Samples for Verification: Actual Sample of finished products for each type of exposed finish.

1. Size: Manufacturer's standard size.

E. Delegated Design Submittals: For panels and support systems, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

1.5 INFORMATIONAL SUBMITTALS

A. Product Test Reports: For each specified product, for tests performed by a qualified testing agency.

B. Qualification Statements: For Installer.

C. Delegated Design Engineer Qualifications: For panels and support systems.

D. Sample Warranties: For specified special warranties.

1.6 CLOSEOUT SUBMITTALS

A. Maintenance Data: For soffit panels.

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1.7 QUALITY ASSURANCE

A. Installer Qualifications: Entity that employs installers and supervisors who are trained and approved by manufacturer.

B. Delegated Design Engineer Qualifications: A professional engineer who is legally qualified to practice in state where Project is located and who is experienced in providing engineering services of the type indicated.

1.8 MOCKUPS

A. Build mockups to verify selections made under Sample submittals, to demonstrate aesthetic effects, and to set quality standards for fabrication and installation.

1. Build mockup of typical roof eave , including fascia, and soffit as indicated on Drawings; approximately four panels wide by full eave width, including attachments, flashing and trim, and accessories.
2. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Owner specifically approves such deviations by Change Order.
3. Approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.9 DELIVERY, STORAGE, AND HANDLING

A. Deliver components, metal panels, and other manufactured items so as not to be damaged or deformed. Package 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. Stack metal panels horizontally on platforms or pallets, covered with suitable weathertight and ventilated covering. Store metal panels to ensure dryness, with positive slope for drainage of water. Do not store metal panels in contact with other materials that might cause staining, denting, or other surface damage.

D. Retain strippable protective covering on metal panels during installation.

E. Copper Panels: Wear gloves when handling to prevent fingerprints and soiling of surface.

1.10 FIELD CONDITIONS

A. Weather Limitations: Proceed with installation only when existing and forecasted weather conditions permit assembly of metal panels to be performed in accordance with manufacturers' written instructions and warranty requirements.

1.11 WARRANTY

A. Special Warranty: Manufacturer agrees to repair or replace components of metal panel systems 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 and other materials beyond normal weathering.

2. Warranty Period: Two years from date of Substantial Completion.

B. Special Warranty on Panel Finishes: Manufacturer agrees to repair finish or replace metal panels that show evidence of deterioration of factory-applied finishes within specified warranty period.

1. Exposed Panel Finish: Deterioration includes, but is not limited to, the following:

   a. Color fading more than 5 Delta E units when tested in accordance with ASTM D2244.

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b. Chalking in excess of a No. 8 rating when tested in accordance with ASTM D4214.
c. Cracking, checking, peeling, or failure of paint to adhere to bare metal.

2. Finish Warranty Period: 20 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Delegated Design: Engage a qualified professional engineer, as defined in Section 014000 "Quality Requirements," to design panels and support systems.

B. Structural Performance: Provide metal panel systems, including associated support system, capable of withstanding the effects of the following loads, based on testing in accordance with ASTM E1592 or ASTM E330/E330M:

1. Wind Loads: As indicated on Drawings.
2. Other Design Loads: As indicated on Drawings.
3. Deflection Limits: For wind loads, no greater than 1/180 of the span.

C. Air Infiltration: Not more than 0.06 cfm/sq. ft. when tested in accordance with ASTM E283/E283M at the following test-pressure difference:

1. Test-Pressure Difference: 1.57 lbf/sq. ft..

D. Water Penetration under Static Pressure: No water penetration when tested in accordance with ASTM E331 at the following test-pressure difference:

1. Test-Pressure Difference: 2.86 lbf/sq. ft..

E. Thermal Movements: Allow for thermal movements from ambient and surface temperature changes.

1. Temperature Change: 120 deg F, ambient; 180 deg F, material surfaces.

F. Fire-Resistance Ratings: Comply with ASTM E119; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.

1. Indicate design designations from UL on its "Product iQ" website or from the listings of another qualified testing agency.

2.2 METAL SOFFIT PANELS

A. General: Provide factory-formed metal soffit panels designed to be installed by lapping and interconnecting side edges of adjacent panels and mechanically attaching through panel to supports using concealed fasteners in side laps. Include accessories required for weathertight installation.

B. Flush-Profile Metal Soffit Panels:

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. AEP Span a brand of ASC Profiles LLC, a part of BlueScope
b. ATAS International, Inc.
c. Berridge Manufacturing Company
d. Carlisle Companies
e. CENTRIA, a Nucor Brand
f. Cornerstone Bldg Brands
g. Dimensional Metals, Inc.
h. Drexel Metals Corp. – Carlisle Construction Materials
i. Elevate; Amrize Building Envelope LLC
j. Englert, Inc.
k. Fabral
l. Innovative Metals Company, Inc
m. Knotwood US LLC

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n. McElroy Metal, Inc
o. Merchant & Evans Inc.
p. Metal Sales Manufacturing Corporation
q. Sentrigard; NB Handy Company
r. Ultra Seam Incorporated

2. Panel Surface: Solid.
3. Panel Profile: Panel formed with vertical panel edges and a flat pan between panel edges; with flush joint between panels.
4. Material: Metallic-coated steel.
5. Panel Coverage: 8 inches.
6. Panel Height: 0.875 inch.

2.3 METAL SOFFIT PANEL MATERIALS

A. Metallic-Coated Steel Sheet: Zinc-coated (galvanized) steel sheet complying with ASTM A653/A653M, **G90** coating designation, or aluminum-zinc alloy-coated steel sheet complying with ASTM A792/A792M, **Class AZ50** coating designation; structural quality. Prepainted by the coil-coating process to comply with ASTM A755/A755M.

1. Nominal Thickness: 0.034 inch.
2. Exterior Finish: Three-coat fluoropolymer.
3. Color: As indicated by manufacturer's designations or As selected by Architect from manufacturer's full range.

B. Aluminum Sheet: Coil-coated sheet, ASTM B209/B209M, alloy as standard with manufacturer, with temper as required to suit forming operations and structural performance required.

1. Thickness: 0.040 inch.
2. Surface: Smooth, flat finish.
3. Exterior Finish: Three-coat fluoropolymer.
4. Color: As indicated by manufacturer's designations or As selected by Architect from manufacturer's full range.

2.4 ACCESSORIES

A. Structural Performance: Provide support system for metal panels capable of withstanding and transferring design loads to building structure within limits and under conditions indicated.

B. Metal Subframing and Furring: ASTM C955, cold-formed, metallic-coated steel sheet, ASTM A653/A653M, **G90** hot-dip galvanized coating designation or ASTM A792/A792M, **Class AZ50** aluminum-zinc-alloy coating designation unless otherwise indicated. Provide manufacturer's standard sections as required for support and alignment of metal panel system.

C. Soffit Panel Assembly Accessories, General: Provide components required for a complete, weathertight panel system including trim, clips, flashings, sealants, gaskets, fillers, and similar items. Match material and finish of metal panels unless otherwise indicated.

1. Closures: Provide closures at panel edges, fabricated of same metal as metal panels.
2. Backing Plates: Provide metal backing plates at panel end splices, fabricated from material recommended in writing by manufacturer.
3. Closure Strips: Closed-cell, expanded, cellular, rubber or crosslinked, polyolefin-foam or closed-cell laminated polyethylene; minimum **1-inch-** thick, flexible closure strips; cut or premolded to match metal panel profile. Provide closure strips where indicated on Drawings or necessary to ensure weathertight construction.

D. Flashing and Trim: Provide flashing and trim formed from same material as metal panels as required to seal against weather and to provide finished appearance. Finish flashing and trim with same finish system as adjacent metal panels.

E. Panel Fasteners: Self-tapping screws designed to withstand design loads. Provide exposed fasteners with heads matching color of metal panels by means of plastic caps or factory-applied coating. Provide EPDM or PVC sealing washers for exposed fasteners.

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F. Panel Sealants: Provide sealant types recommended in writing by manufacturer that are compatible with panel materials, are nonstaining, and do not damage panel finish.

1. Sealant Tape: Pressure-sensitive, 100 percent solids, gray polyisobutylene compound sealant tape with release-paper backing. Provide permanently elastic, nonsag, nontoxic, nonstaining tape **1/2 inch** wide and **1/8 inch** thick.
2. Joint Sealant: ASTM C920; elastomeric polyurethane or silicone sealant; of type, grade, class, and use classifications required to seal joints in metal panels and remain weathertight; and as recommended in writing by metal panel manufacturer.
3. Butyl-Rubber-Based, Solvent-Release Sealant: ASTM C1311.

2.5 FABRICATION OF METAL SOFFIT PANELS

A. Fabricate and finish metal panels and accessories at the factory, by panel manufacturer's standard procedures and processes, as necessary to fulfill indicated performance requirements demonstrated by laboratory testing. Comply with indicated profiles and with dimensional and structural requirements.

B. On-Site Fabrication: Subject to compliance with requirements of this Section, metal panels may be fabricated on-site using UL-certified, portable roll-forming equipment if panels are of same profile and warranted by manufacturer to be equal to factory-formed panels. Fabricate in accordance with equipment manufacturer's written instructions and to comply with details shown.

C. Fabricate metal panel joints with factory-installed captive gaskets or separator strips that provide a weathertight seal and prevent metal-to-metal contact, and that minimize noise from movements.

D. Sheet Metal Flashing and Trim: Fabricate flashing and trim to comply with manufacturer's written instructions that apply to 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. Seams for Other Than Aluminum: Fabricate nonmoving seams in accessories with flat-lock seams. Tin edges to be seamed, form seams, and solder.
4. Sealed Joints: Form nonexpansion, but movable, joints in metal to accommodate sealant and to comply with manufacturer's written instructions.
5. Conceal fasteners and expansion provisions where possible. Exposed fasteners are not allowed on faces of accessories exposed to view.
6. Fabricate cleats and attachment devices from same material as accessory being anchored or from compatible, noncorrosive metal recommended in writing by metal panel manufacturer.

    a. Size: As recommended in writing by metal soffit panel manufacturer for application, but not less than thickness of metal being secured.

2.6 FINISHES

A. Protect mechanical and painted finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.

B. Appearance of Finished Work: Variations in appearance of abutting or adjacent pieces are acceptable if they are within one-half of the range of approved Samples. Noticeable variations in same piece are unacceptable. Variations in appearance of other components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

C. Metallic-Coated Steel Panels and Accessories:

1. Three-Coat Fluoropolymer: AAMA 2605. Fluoropolymer finish containing not less than 70 percent PVDF resin by weight in both color coat and clear topcoat. Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions .

D. Aluminum Panels and Accessories:

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1. Three-Coat Fluoropolymer: AAMA 2605. Fluoropolymer finish containing not less than 70 percent PVDF resin by weight in both color coat and clear topcoat. Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions .

PART 3 - EXECUTION

3.1 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 the Work.

1. Examine framing to verify that 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 sheathing to verify that sheathing joints are supported by framing or blocking and that installation is within flatness tolerances required in writing by metal panel manufacturer.

   a. Verify that air- or water-resistive barriers have been installed over sheathing or backing substrate to prevent air infiltration or water penetration.

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 installation.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Miscellaneous Supports: Install steel subframing, furring, and other miscellaneous support system members and anchorages in accordance with metal panel manufacturer's written instructions.

3.3 INSTALLATION OF METAL SOFFIT PANELS

A. Install in accordance with metal panel manufacturer's written instructions in orientation, sizes, and locations indicated. Install panels perpendicular to supports unless otherwise indicated. Anchor metal panels and other components of the Work securely in place, with provisions for thermal and structural movement.

1. Shim or otherwise plumb substrates receiving metal panels.
2. Flash and seal metal panels at perimeter of all openings. Fasten with self-tapping screws. Do not begin installation until air- or water-resistive barriers and flashings that will be concealed by metal panels are installed.
3. Install screw fasteners in predrilled holes.
4. Locate and space fastenings in uniform vertical and horizontal alignment.
5. Install flashing and trim as metal panel work proceeds.
6. Locate panel splices over, but not attached to, structural supports. Stagger panel splices and end laps to avoid a four-panel lap splice condition.
7. Align metal panels and fasten with blind rivets, bolts, or self-tapping screws. Fasten flashings and trim around openings and similar elements with self-tapping screws.
8. Provide weathertight escutcheons for pipe- and conduit-penetrating panels.

B. Panel Fasteners:

1. Metallic-Coated Steel Panels: Use stainless steel fasteners for surfaces exposed to the exterior; use galvanized-steel fasteners for surfaces exposed to the interior.
2. Aluminum Panels: Use aluminum or stainless steel fasteners for surfaces exposed to the exterior; use aluminum fasteners for surfaces exposed to the interior.
3. Copper Panels: Use copper, stainless steel, or hardware-bronze fasteners.
4. Stainless Steel Panels: Use stainless steel fasteners.
5. Zinc-Alloy Panels: Use zinc fasteners recommended in writing by manufacturer.

C. Metal Protection: Where dissimilar metals contact each other or corrosive substrates, protect against

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galvanic action as recommended in writing by metal panel manufacturer.

D. Fasten metal soffit panels to supports with fasteners at each lapped joint at location and spacing recommended in writing by manufacturer.

1. Apply panels and associated items true to line for neat and weathertight enclosure.
2. Provide metal-backed washers under heads of exposed fasteners bearing on weather side of metal panels.
3. Locate and space exposed fasteners in uniform vertical and horizontal alignment. Use proper tools to obtain controlled uniform compression for positive seal without rupture of washer.
4. Install screw fasteners with power tools having controlled torque adjusted to compress washer tightly without damage to washer, screw threads, or panels. Install screws in predrilled holes.

E. Weathertight Installation:

1. Apply a continuous ribbon of sealant or tape to seal lapped joints of metal panels, using sealant or tape as recommend in writing by manufacturer on side laps of nesting-type panels and elsewhere as needed to make panels weathertight.
2. Provide sealant or tape between panels and protruding equipment, vents, and accessories.
3. At panel splices, nest panels with minimum **6-inch** end lap, sealed with sealant and fastened together by interlocking clamping plates.

3.4 INSTALLATION OF ACCESSORIES

A. Install accessories with positive anchorage to building and provide for thermal expansion. Coordinate installation with flashings and other components.

1. Install components required for a complete metal panel system including trim, corners, seam covers, flashings, sealants, gaskets, fillers, closure strips, and similar items. Provide types indicated by metal panel manufacturer; or, if not indicated, provide types recommended in writing by metal panel manufacturer.

B. Flashing and Trim: Comply with performance requirements and with manufacturer's written installation instructions. Provide concealed fasteners where possible, and set units true to line and level as indicated. Install work with laps, joints, and seams that are permanently weathertight.

1. Install exposed flashing and trim that is without buckling, and tool marks, and that is true to line and levels indicated, with exposed edges folded back to form hems. Install sheet metal flashing and trim to fit substrates and to achieve waterproof performance.
2. Expansion Provisions: Provide for thermal expansion of exposed flashing and trim. Space movement joints at a maximum of **10 ft.** with no joints allowed within **24 inches** of corner or intersection. Where lapped expansion provisions cannot be used or would not be waterproof, form expansion joints of intermeshing hooked flanges, not less than **1 inch** deep, filled with mastic sealant (concealed within joints).

3.5 INSTALLATION TOLERANCES

A. Shim and align metal soffit panel units within installed tolerance of **1/4 inch in 20 ft.**, non-accumulative, on level, plumb, and location lines as indicated on Drawings, and within **1/8-inch** offset of adjoining faces and of alignment of matching profiles.

3.6 CLEANING

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 in writing by metal panel manufacturer.

B. After installation, clear weep holes and drainage channels of obstructions, dirt, and sealant.

3.7 PROTECTION

A. Maintain metal panels in a clean condition during the remainder of construction.

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B. Replace metal panels that have been damaged or have deteriorated beyond successful repair by finish touchup or similar minor repair procedures.

END OF SECTION 07 42 93

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SECTION 07 46 46 - FIBER-CEMENT SIDING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Fiber-cement siding.

B. Related Requirements:

1. Section 061000 "Rough Carpentry" for wood furring, grounds, nailers, and blocking.
2. Section 072500 "Weather Barriers" for weather-resistive barriers.

1.2 COORDINATION

A. Coordinate siding installation with flashings and other adjoining construction to ensure proper sequencing.

1.3 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site .

1.4 ACTION SUBMITTALS

A. Product Data:

1. Fiber-cement siding.

B. Product Data Submittals: For each type of fiber-cement siding . Include construction details, material descriptions, dimensions of individual components and profiles, and finishes.

C. Samples for Initial Selection: For fiber-cement siding including related accessories.

D. Samples for Verification: For each type, color, texture, and pattern required.

1. **12-inch-** long-by-actual-width Sample of siding.
2. **24-inch-** wide-by-**36-inch-** high Sample panel of siding assembled on plywood backing.
3. **12-inch-** long-by-actual-width Sample of soffit.
4. **12-inch-** long-by-actual-width Samples of trim and accessories.

1.5 INFORMATIONAL SUBMITTALS

A. Product Certificates: For each type of fiber-cement siding .

B. Product Test Reports: Based on evaluation of comprehensive tests performed by a qualified testing agency, for fiber-cement siding.

C. Research/Evaluation Reports: For each type of fiber-cement siding required, from ICC-ES.

D. Sample Warranty: For special warranty.

1.6 CLOSEOUT SUBMITTALS

A. Maintenance Data: For each type of fiber-cement siding , including related accessories, to include in maintenance manuals.

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1.7 MAINTENANCE MATERIAL SUBMITTALS

A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Furnish full lengths of fiber-cement siding including related accessories, in a quantity equal to 2 percent of amount installed.

1.8 MOCKUPS

A. Build mockups to verify selections made under Sample submittals and to demonstrate aesthetic effects and to set quality standards for fabrication and installation.

1. Build mockup of typical wall area as shown on Drawings.
2. Build mockups for fiber-cement siding including accessories.

   a. Size: 48 inches long by 60 inches high .
   b. Include outside corner on one end of mockup and inside corner on other end .

3. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Architect specifically approves such deviations in writing.
4. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.9 DELIVERY, STORAGE, AND HANDLING

A. Deliver and store packaged materials in original containers with labels intact until time of use.

B. Store materials on elevated platforms, under cover, and in a dry location.

1.10 WARRANTY

A. Special Warranty: Manufacturer agrees to repair or replace products that fail in materials or workmanship within specified warranty period.

1. Failures include, but are not limited to, the following:

   a. Structural failures including cracking and deforming.
   b. Deterioration of materials beyond normal weathering.

2. Warranty Period: 10 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 SOURCE LIMITATIONS

A. Obtain products, including related accessories, from single source from single manufacturer.

2.2 FIBER-CEMENT SIDING

A. Fiber-Cement Siding: ASTM C1186, Type A, Grade II, fiber-cement board, noncombustible when tested in accordance with ASTM E136; with a flame-spread index of 25 or less when tested in accordance with ASTM E84.

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following :

   a. Allura
   b. American Fiber Cement Corporation
   c. CertainTeed; Saint-Gobain North America
   d. GAF Materials Corporation
   e. James Hardie Building Products, Inc.

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f. Nichiha USA, Inc.

B. Labeling: Provide fiber-cement siding that is tested and labeled in accordance with ASTM C1186 by a qualified testing agency acceptable to authorities having jurisdiction.

C. Nominal Thickness: Not less than **5/16 inch**.

D. Horizontal Pattern: Boards 6-1/4 to 6-1/2 inches wide in plain style or as indicated in the drawings.

1. Texture: As indicated in the drawings .

E. Panel Texture: **48-inch-** wide sheets with wood-grain texture and battens.

F. Factory Priming: Manufacturer's standard acrylic primer.

2.3 ACCESSORIES

A. Siding Accessories, General: Provide starter strips, edge trim, outside and inside corner caps, and other items as recommended by siding manufacturer for building configuration.

1. Provide accessories matching color and texture of adjacent siding unless otherwise indicated.

B. Decorative Accessories: Provide the following fiber-cement decorative accessories as indicated:

1. Corner posts.
2. Door and window casings.
3. Fasciae.
4. Moldings and trim.
5. Battens .

C. Flashing: Provide aluminum flashing complying with Section 076200 "Sheet Metal Flashing and Trim" at window and door heads and where indicated.

1. Finish for Aluminum Flashing: Siliconized polyester coating .

D. Fasteners:

1. For fastening to wood, use siding nails of sufficient length to penetrate a minimum of **1 inch** into substrate.
2. For fastening to metal, use ribbed bugle-head screws of sufficient length to penetrate a minimum of **1/4 inch**, or three screw-threads, into substrate.
3. For fastening fiber cement, use hot-dip galvanized fasteners.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates for compliance with requirements for installation tolerances and other conditions affecting performance of fiber-cement siding and related accessories.

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

3.2 PREPARATION

A. Clean substrates of projections and substances detrimental to application.

3.3 INSTALLATION

A. General: Comply with manufacturer's written installation instructions applicable to products and applications indicated unless more stringent requirements apply.

1. Do not install damaged components.
2. Install fasteners no more than 24 inches o.c.

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B. Install joint sealants as specified in Section 079200 "Joint Sealants" and to produce a weathertight installation.

3.4 ADJUSTING AND CLEANING

A. Remove damaged, improperly installed, or otherwise defective materials and replace with new materials complying with specified requirements.

B. Clean finished surfaces according to manufacturer's written instructions and maintain in a clean condition during construction.

END OF SECTION 07 46 46

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SECTION 07 54 23 - THERMOPLASTIC-POLYOLEFIN (TPO) ROOFING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Thermoplastic polyolefin (TPO) roofing system.
2. Accessory roofing system materials.
3. Roof insulation and accessories.

B. Section contains the installation of sound-absorbing insulation strips in ribs of acoustical steel roof deck. Sound-absorbing insulation strips are furnished under Section 053100 "Steel Decking."

C. Related Requirements:

1. Section 053100 "Steel Decking" for roof deck panels .
2. Section 061000 "Rough Carpentry" for wood nailers, curbs, and blocking; and for wood-based, structural-use roof deck panels.
3. Section 061600 "Sheathing" for wood-based, structural-use roof deck panels.
4. Section 076200 "Sheet Metal Flashing and Trim" for metal roof flashings and counterflashings.
5. Section 077100 "Roof Specialties" for roof edge flashings.
6. Section 077129 "Manufactured Roof Expansion Joints" for premanufactured roof expansion-joint assemblies.
7. Section 077200 "Roof Accessories" for manufactured roof curbs, equipment supports, roof hatches, vents, and other manufactured roof accessory units.
8. Section 079200 "Joint Sealants" for joint sealants, joint fillers, and joint preparation.

1.2 DEFINITIONS

A. Roofing Terminology: Definitions in ASTM D1079 and glossary in NRCA's " Roofing Manual: Membrane Roof Systems" apply to Work of this Section.

1.3 PREINSTALLATION MEETINGS

A. Preliminary Roofing Conference: Before starting roof deck construction, conduct conference at Project site.

1. Meet with Owner, Architect, Owner's insurer if applicable, testing and inspecting agency representative, roofing system Installer, roofing system manufacturer's representative, deck Installer, air barrier Installer, and installers whose work interfaces with or affects roofing, including installers of roof accessories and roof-mounted equipment.
2. Review methods and procedures related to roofing installation, including manufacturer's written instructions.
3. Review and finalize construction schedule, and verify availability of materials, Installer's personnel, equipment, and facilities needed to make progress and avoid delays.
4. Review deck substrate requirements for conditions and finishes, including flatness and fastening.
5. Review structural loading limitations of roof deck during and after roofing.
6. Review base flashings, special roofing details, roof drainage, roof penetrations, equipment curbs, and condition of other construction that affects roofing system.
7. Review governing regulations and requirements for insurance and certificates if applicable.
8. Review temporary protection requirements for roofing system during and after installation.
9. Review roof observation and repair procedures after roofing installation.

B. Preinstallation Roofing Conference: Conduct conference at Project site.

1. Meet with Owner, Architect, Owner's insurer if applicable, testing and inspecting agency representative, roofing system Installer, roofing system manufacturer's representative, deck

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Installer, air barrier Installer, and installers whose work interfaces with or affects roofing, including installers of roof accessories and roof-mounted equipment.
2. Review methods and procedures related to roofing installation, including manufacturer's written instructions.
3. Review and finalize construction schedule, and verify availability of materials, Installer's personnel, equipment, and facilities needed to make progress and avoid delays.
4. Examine deck substrate conditions and finishes for compliance with requirements, including flatness and fastening.
5. Review structural loading limitations of roof deck during and after roofing.
6. Review base flashings, special roofing details, roof drainage, roof penetrations, equipment curbs, and condition of other construction that affects roofing system.
7. Review governing regulations and requirements for insurance and certificates if applicable.
8. Review temporary protection requirements for roofing system during and after installation.
9. Review roof observation and repair procedures after roofing installation.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of specified product.

B. Shop Drawings: Include roof plans, sections, details, and attachments to other work, including the following:

1. Layout and thickness of insulation.
2. Base and sheet flashings and membrane termination details.
3. Flashing details at penetrations.
4. Tapered insulation layout, thickness, and slopes.
5. Roof plan showing orientation of roof deck and orientation of roofing membrane, fastening spacings, and pattern for corner, perimeter, and field-of-roof locations.
6. Insulation fastening patterns for corner, perimeter, and field-of-roof locations.
7. Crickets, saddles, and tapered edge strips, including slopes.
8. Tie-in with adjoining wall system air barrier.

C. Samples for Verification: For the following products:

1. Roofing membrane and flashings, of color required.
2. Walkways, of color required.

D. Wind-Uplift-Resistance Submittal: For roofing system indicating compliance with wind-uplift performance requirements.

1.5 INFORMATIONAL SUBMITTALS

A. Manufacturer Certificates:

1. Performance Requirement Certificate: Signed by roofing membrane manufacturer, certifying that roofing system complies with requirements specified in "Performance Requirements" Article.

   a. Submit evidence of compliance with specified performance requirements.

2. Special Warranty Certificate: Signed by roofing membrane manufacturer, certifying that all materials supplied under this Section are acceptable for special warranty.

B. Product Test Reports: For roofing membrane and insulation, tests performed by an independent qualified testing agency indicating compliance with specified requirements.

C. Research Reports: For components of roofing system, from ICC-ES showing compliance with specified performance requirements.

D. Field Test Reports:

1. Concrete internal relative humidity test reports.
2. Fastener-pullout test results and manufacturer's revised requirements for fastener patterns.

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E. Field Quality Control Reports: For specified tests and inspections.

F. Qualification Statements: For roofing system Installer.

G. Sample Warranties: For specified special warranties.

1.6 CLOSEOUT SUBMITTALS

A. Maintenance Data: For roofing system.

B. Existing Warranty Documentation: Certified statement from existing roofing system manufacturer stating that existing roof warranty has not been affected by the Work performed under this Section.

1.7 QUALITY ASSURANCE

A. Manufacturer Qualifications: A qualified manufacturer that is listed in FM Approvals' RoofNav for roofing system identical to that used for this Project.

B. Roofing System 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 special warranty.

1. Certified Roofing System Installer: Entity that employs a supervisor who is an NRCA ProCertified Roofing Foreman or installers who are NRCA ProCertified thermoplastic system installers.

1.8 DELIVERY, STORAGE, AND HANDLING

A. Deliver roofing system materials to Project site in original containers with seals unbroken and labeled with manufacturer's name, product brand name and type, date of manufacture, approval or listing agency markings, and directions for storing and mixing with other components.

B. Store liquid materials in their original undamaged containers in a clean, dry, protected location and within the temperature range required by roofing system manufacturer.

1. Protect stored liquid material from direct sunlight.
2. Discard and legally dispose of liquid material that cannot be applied within its stated shelf life.

C. Protect roof insulation materials from physical damage and from deterioration by sunlight, moisture, soiling, and other sources.

1. Store in a dry location.
2. Comply with insulation manufacturer's written instructions for handling, storing, and protecting during installation.

D. Handle and store roofing system materials, and place equipment in a manner to avoid permanent deflection of deck.

1.9 FIELD CONDITIONS

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

1.10 WARRANTY

A. Special Warranty: Manufacturer agrees to repair or replace components of roofing system that fail in materials or workmanship within specified warranty period.

1. Special warranty to include all components of roofing system, such as roof insulation, fasteners, adhesives, roofing membrane, base flashing sheet, walkways, and other components of roofing system.
2. Warranty Period: 15 years from date of Substantial Completion.

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B. Roofing System Installer's Warranty: Submit roofing system Installer's warranty, on warranty form at end of this Section, signed by roofing system Installer, covering the Work of this Section, including all components of roofing system, such as roof insulation, fasteners, adhesives, roofing membrane, base flashing sheet, walkways, and other components of roofing system.

1. Warranty Period: Two years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 SOURCE LIMITATIONS

A. Obtain components for roofing system from roofing membrane manufacturer.

2.2 PERFORMANCE REQUIREMENTS

A. General Performance: Installed roofing system and flashings to withstand specified uplift pressures, thermally induced movement, and exposure to weather without failure due to defective manufacture, fabrication, installation, or other defects in construction. Roofing system and flashings to remain watertight.

1. Accelerated Weathering: Roofing membrane to withstand 2000 hours of exposure when tested in accordance with ASTM G152, ASTM G154, or ASTM G155.
2. Impact Resistance: Roofing membrane to resist impact damage when tested in accordance with ASTM D3746/D3746M, ASTM D4272/D4272M, or the Resistance to Foot Traffic Test in FM Approvals 4470.

B. Material Compatibility: Roofing system materials to be compatible with one another and adjacent materials under conditions of service and application required, as demonstrated by roofing membrane manufacturer based on testing and field experience.

C. Wind-Uplift Resistance: Design roofing system to resist the following wind-uplift pressures when tested in accordance with FM Approvals 4474, UL 580, or UL 1897:

1. Zone 1' (Roof Area Interior): **See drawings**.
2. Zone 1 (Roof Area Field): **See drawings**.
3. Zone 2 (Roof Area Perimeter): **See drawings**.
4. Zone 3 (Roof Area Corners): **See drawings**.

D. FM Approvals' RoofNav Listing: Roofing membrane, base flashings, and component materials to comply with requirements in FM Approvals 4450 or FM Approvals 4470 as part of a roofing system and are listed in FM Approvals' RoofNav for Class 1 or noncombustible construction, as applicable. Identify materials with FM Approvals Certification markings.

1. Fire/Windstorm Classification: Class 1A-105.
2. Hail-Resistance Rating: FM Global Property Loss Prevention Data Sheet 1-34 MH.

E. SPRI's "Directory of Roof Assemblies" Listing: Roofing membrane, base flashings, and component materials to comply with requirements in FM Approvals 4450 or FM Approvals 4470 as part of a roofing system and are listed in SPRI's "Directory of Roof Assemblies" for roof assembly identical for that specified for this Project.

1. Wind-Uplift Load Capacity: 105 psf.

F. Cool Roof Rating Council (CRRC): Roofing system to be listed by the CRRC for low-slope roof products.

G. Energy Performance: Roofing system to have an initial solar reflectance index (SRI) of not less than 0.70 and an emissivity of not less than 0.75 when tested in accordance with CRRC S100.

H. Exterior Fire-Test Exposure: Class A; for application and roof slopes indicated; when tested by a qualified testing agency in accordance with ASTM E108 or UL 790.

1. Identify products with appropriate markings of applicable testing agency.

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I. Fire-Resistance Ratings: Comply with fire-resistance-rated assembly designs indicated.

1. Identify products with appropriate markings of applicable testing agency.

2.3 THERMOPLASTIC POLYOLEFIN (TPO) ROOFING SYSTEM

A. TPO Roofing Membrane Sheet: ASTM D6878/D6878M, internally fabric- or scrim-reinforced, TPO sheet.

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. Carlisle Construction Materials; Carlisle Companies
b. Cooley Group
c. Custom Seal Inc.
d. Elevate; Amrize Building Envelope LLC
e. Flex Membrane International Corp.
f. GAF Materials Corporation
g. GenFlex Roofing Systems
h. IKO Innovi; IKO Industries, Inc.
i. Johns Manville; a Berkshire Hathaway company
j. Mule-Hide Products Co., Inc
k. Siplast

2. Membrane Option: Manufacturer's standard.
3. Thickness: 60 mils, nominal.
4. Exposed Face Color: White.

2.4 ACCESSORY ROOFING SYSTEM MATERIALS

A. General: Accessory materials as recommended in writing by roofing membrane manufacturer for intended use and compatible with other roofing system components.

1. Adhesive and Sealants: Comply with VOC limits of authorities having jurisdiction.

B. Base and Sheet Flashings: Manufacturer's standard sheet flashing of same material, type, reinforcement, thickness, and color as roofing membrane.

C. Prefabricated Pipe Flashings: As recommended in writing by roofing membrane manufacturer.

D. Roof Vents: As recommended in writing by roofing membrane manufacturer.

1. Size: Not less than **4-inch** diameter.

E. Bonding Adhesive: Roofing membrane manufacturer's standard .

F. Slip Sheet: Manufacturer's standard, of thickness required for application.

G. Asphalt-Coated, Glass-Fiber-Mat, Venting Base Sheet: ASTM D4897/D4897M, Type II; nonperforated, asphalt impregnated, fiberglass reinforced, with mineral granular patterned surfacing on bottom surface.

H. Metal Termination Bars: Manufacturer's standard, predrilled stainless steel or aluminum bars, approximately **1 by 1/8 inch** thick; with anchors.

I. Metal Battens: Manufacturer's standard, aluminum-zinc-alloy-coated or zinc-coated steel sheet, approximately **1 inch wide by 0.05 inch thick**, prepunched.

J. Fasteners: Factory-coated steel fasteners and metal or plastic plates complying with corrosion-resistance provisions in FM Approvals 4470, designed for fastening roofing system components to substrate; tested for required pullout strength, and acceptable to roofing membrane manufacturer.

K. Safety Accessories: Roofing membrane manufacturer's standard yellow seaming tape for designating safety perimeters and rooftop hazards.

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L. Miscellaneous Accessories: As recommended in writing by roofing membrane manufacturer.

2.5 SUBSTRATE BOARD

A. Fasteners: Factory-coated steel fasteners and metal or plastic plates complying with corrosion-resistance provisions in FM Approvals 4470, designed for fastening substrate board to roof deck.

B. Bonding Adhesive: Manufacturer's standard, designed for adhering substrate board to roof deck.

2.6 ROOF INSULATION AND ACCESSORIES

A. General: Preformed roof insulation boards manufactured by roofing membrane manufacturer, approved for use in FM Approvals' RoofNav listed roof assemblies.

B. Polyisocyanurate Board Insulation: ASTM C1289, Type II, Class 1 felt facer on both major surfaces.

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

    a. Atlas Polyiso Roof and Wall Insulation
    b. Carlisle Construction Materials; Carlisle Companies
    c. CertainTeed; Saint-Gobain North America
    d. Elevate; Amrize Building Envelope LLC
    e. GAF Materials Corporation
    f. Hunter Panels; a Carlisle company
    g. IKO Innovi; IKO Industries, Inc.
    h. Johns Manville; a Berkshire Hathaway company
    i. Polyglass U.S.A., Inc.
    j. Rmax, A Business Unit of Sika Corporation

2. Compressive Strength: Grade 2, 20 psi.
3. Size: 48 by 48 inches.
4. Thickness:

    a. Base Layer: 1-1/2 inches.
    b. Upper Layer(s): As needed to achieve minimum R-Value indicated.

C. Mineral Wool Board Insulation - Multi-Density: ASTM C726, Type I, Class 1, comprising monolithic fibrous material having an upper layer of **11.2 lb/cu. ft.** density, and a lower layer of **7.5 lb/cu. ft.** density.

1. Thermal Resistance: R-value of 3.8 per **1 inch**.
2. Size: **48 by 48 inches**.
3. Thickness:

    a. Base Layer: 2 inches.
    b. Upper Layer: <**Insert thickness**>.

D. Mineral Wool Board Insulation - Single Density: ASTM C726, Type II, Class 1, comprising monolithic fibrous material having **12.5 lb/cu. ft.** density.

1. Thermal Resistance: R-value of 4.0 per **1 inch**.
2. Size: **48 by 48 inches**.
3. Thickness: **1 inch**.

E. Tapered Insulation: Provide factory-tapered insulation boards.

1. Material: Match roof insulation.
2. Minimum Thickness: **1/4 inch**.
3. Slope:

    a. Roof Field: 1/4 inch per foot unless otherwise indicated on Drawings.
    b. Saddles and Crickets: 1/2 inch per foot unless otherwise indicated on Drawings.

F. Roof Insulation Accessories, General: As recommended in writing by insulation manufacturer for

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intended use and compatibility with other roofing system components.

1. Insulation Adhesive: Insulation manufacturer's recommended adhesive formulated to attach roof insulation to substrate and to another insulation layer as follows:

    a. Modified asphaltic, asbestos-free, cold-applied adhesive.
    b. Bead-applied, low-rise, one-component or multicomponent urethane adhesive.
    c. Full-spread, spray-applied, low-rise, two-component urethane adhesive.

2. Insulation Fasteners: Insulation manufacturer's standard factory-coated steel fasteners with metal or plastic plates complying with corrosion-resistance provisions in FM Approvals 4470, designed for fastening roof insulation to substrate, and acceptable to roofing system manufacturer.
3. Induction-Welding Plates: Minimum **3-inch** diameter with recessed center, **0.034-inch** thick, aluminum-zinc-alloy-coated steel plates, factory coated with adhesive formulated for roof membrane, with corresponding corrosion-resistant fasteners .

2.7 WALKWAYS

A. Flexible Walkways: Factory-formed, nonporous, heavy-duty, slip-resisting, surface-textured walkway pads or rolls, approximately **3/16 inch** thick and acceptable to roofing system manufacturer.

1. Size: Approximately **36 by 60 inches**.
2. Color: Contrasting with roofing membrane.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions, with roofing system Installer present, for compliance with requirements and other conditions affecting performance of the Work.

1. Verify that roof openings and penetrations are in place, curbs are set and braced, and roof-drain bodies are securely clamped in place.
2. Verify that wood blocking, curbs, and nailers are securely anchored to roof deck at penetrations and terminations and that nailers match thicknesses of insulation.
3. Verify that surface plane flatness and fastening of steel roof deck complies with requirements in Section 053100 "Steel Decking."
4. Verify that deck is securely fastened with no projecting fasteners and with no adjacent units in excess of **1/16 inch** out of plane relative to adjoining deck.
5. Verify that minimum concrete drying period recommended by roofing system manufacturer has passed.
6. Verify that concrete substrate is visibly dry and free of moisture, and that minimum concrete internal relative humidity is not more than 75 percent, or as recommended by roofing system manufacturer, when tested in accordance with ASTM F2170.

    a. Test Frequency: One test probe per each 1000 sq. ft., or portion thereof, of roof deck, with not less than three tests probes.
    b. Submit test reports within 24 hours after performing tests.

7. Verify that concrete-curing compounds that will impair adhesion of roofing components to roof deck have been removed.
8. Verify that joints in precast concrete roof decks have been grouted flush with top of concrete.
9. Verify that minimum curing period recommended by roofing system manufacturer for lightweight insulating concrete roof decks has passed.
10. Verify any damaged sections of cementitious wood-fiber decks have been repaired or replaced.
11. Verify adjacent cementitious wood-fiber panels are vertically aligned to within **1/8 inch** at top surface.

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

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3.2 PREPARATION

A. Clean substrate of dust, debris, moisture, and other substances detrimental to roofing system installation in accordance with roofing system manufacturer's written instructions. Remove sharp projections.

B. Prevent materials from entering and clogging roof drains and conductors and from spilling or migrating onto surfaces of other construction. Remove roof-drain plugs when no work is taking place or when rain is forecast.

C. Prime surface of concrete deck with primer in accordance with roofing system manufacturer's written installation instructions and allow primer to dry.

D. Perform fastener-pullout tests in accordance with roofing system manufacturer's written instructions.

1. Submit test result within 24 hours after performing tests.

a. Include manufacturer's requirements for any revision to previously submitted fastener patterns required to achieve specified wind uplift requirements.

E. Install sound-absorbing insulation strips in ribs of acoustical steel roof deck in accordance with roof deck manufacturer's written instructions.

3.3 INSTALLATION OF THERMOPLASTIC-POLYOLEFIN (TPO) ROOFING SYSTEM

A. Install roofing system materials and components in accordance with roofing system manufacturer's written installation instructions, FM Approvals' RoofNav listed roof assembly requirements, and FM Global Property Loss Prevention Data Sheet 1-29.

B. Complete terminations and base flashings and provide temporary seals to prevent water from entering completed sections of roofing system at end of workday or when rain is forecast. Remove and discard temporary seals before beginning Work on adjoining roofing.

C. Install roofing membrane and auxiliary materials to tie in to existing roofing to maintain weathertightness of transition and to not void warranty for existing roofing system.

D. Substrate-Joint Penetrations: Prevent adhesives from penetrating substrate joints, entering building, or damaging roofing system components or adjacent building construction.

3.4 INSTALLATION OF ROOF INSULATION AND ACCESSORIES

A. Coordinate installation of roofing system components so insulation is not exposed to precipitation or left exposed at end of workday.

B. Comply with roofing system and insulation manufacturer's written installation instructions. Install minimum of two layers of insulation under area of roofing to achieve required thickness.

C. Install each layer of insulation with joints staggered not less than 24 inches in adjacent rows and offset not less than **12 inches** from previous layer.

1. Trim insulation neatly to fit around penetrations and projections, and to fit tightly to intersecting sloping roof decks.
2. Make joints between adjacent insulation boards not more than **1/4 inch** in width.
3. At internal roof drains, slope insulation to create a square drain sump, with each side equal to the diameter of the drain bowl plus **24 inches**.
4. Trim insulation, so that water flow is unrestricted.
5. Fill gaps exceeding **1/4 inch** with insulation.
6. Cut and fit insulation within **1/4 inch** of nailers, projections, and penetrations.
7. Secure insulation in accordance with FM Approvals' RoofNav for specified Windstorm Resistance Classification.
8. Secure insulation to resist specified uplift pressure at corners, perimeter, and field of roof.
9. Place plates on insulation in required fastening patterns to achieve FM rating and secure in accordance with manufacturer's instructions.

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a. Install plates and fasteners tight and flat to substrate with no dimpling, and with fastener extending **1 inch** minimum into roof deck; do not overdrive fasteners.

10. Loosely lay each layer of insulation over substrate.

3.5 INSTALLATION OF TPO ROOFING MEMBRANE SHEET

A. Install roofing membrane over roof area for adhered or mechanically attached application method in accordance with roofing system manufacturer's written installation instructions.

B. Unroll roofing membrane and allow it to relax before installing.

C. Start installation in presence of roofing system manufacturer's technical personnel .

D. Accurately align roofing membrane and maintain uniform side and end laps of minimum dimensions required by manufacturer. Stagger end laps. Apply roofing membrane with side laps shingled with slope of roof deck where possible.

E. Adhered Application: Apply bonding adhesive to substrate and underside of roofing membrane at rate required by manufacturer and allow to partially dry before installing roofing membrane. Do not apply to splice area of roofing membrane.

1. In addition to adhering, mechanically fasten roofing membrane securely at terminations, penetrations, and perimeter of roof area.

F. Mechanically Attached Application: Secure roofing membrane over area to receive roofing in accordance with roofing system manufacturer's written installation instructions.

1. Mechanically fasten or adhere roof membrane securely at terminations, penetrations, and perimeter of roofing.
2. Induction-Weld Attachment: Secure roofing membrane to plates creating 100 percent bond between underside of membrane and top of plates; a partial bond is unacceptable. Test welds to verify adhesion of roofing membrane to top of plates in accordance with manufacturer's instructions.

G. Seams and End Laps: Clean seam areas, overlap membrane, and hot-air-weld side seams and end laps of roofing membrane and sheet flashings to ensure a watertight installation.

1. Test lap edges with probe to verify seam weld continuity. Apply lap sealant to seal cut edges of roofing membrane and sheet flashings.
2. Verify field strength of seams a minimum of twice daily, and repair seam sample areas.
3. Repair tears, voids, and lapped seams in roofing membrane that do not comply with requirements.

H. Spread sealant bed over deck-drain flange at roof drains, and securely seal roofing membrane in place with clamping ring.

3.6 INSTALLATION OF BASE AND SHEET FLASHINGS

A. General: Install and adhere base and sheet flashing and preformed flashing accessories to substrates in accordance with roofing system manufacturer's written installation instructions.

B. Apply bonding adhesive to substrate and underside of flashings at required rate and allow to partially dry. Do not apply to seam area of flashing.

C. Flash penetrations and field-formed inside and outside corners.

D. Clean seam areas, overlap, and firmly roll flashings into the adhesive. Hot-air-weld side seams and end laps to ensure a watertight installation.

E. Terminate and seal top of flashings and mechanically anchor to substrate through termination bars.

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3.7 FIELD QUALITY CONTROL

A. Testing Agency: Owner will engage a qualified testing agency to perform tests and inspect substrate conditions, surface preparation, and installation of roofing membrane, flashings, protection, and drainage components, and to furnish reports to Architect.

B. Final Roof Inspection: Arrange for roofing system manufacturer's technical personnel to inspect roofing installation on completion, in presence of Architect, and to prepare inspection report.

1. Notify Architect 48 hours in advance of date and time of inspection.

C. Repair or remove and replace components of roofing system where inspections indicate that they do not comply with specified requirements.

D. Additional testing and inspecting, at Contractor's expense, will be performed to determine if replaced or additional work complies with specified requirements.

1. Roofing system will be considered defective if it does not pass tests and inspections.

E. Prepare test and inspection reports.

3.8 CLEANING

A. Clean overspray and spillage from adjacent construction using cleaning agents and procedures recommended by manufacturer of affected construction.

3.9 PROTECTION

A. Protect roofing system from damage and wear during remainder of construction period. When remaining construction does not affect or endanger roofing system, inspect roofing system for deterioration and damage, describing its nature and extent in a written report, with copies to Architect and Owner.

B. Correct deficiencies in or remove roofing system that does not comply with requirements, repair substrates, and repair or reinstall roofing system to a condition free of damage and deterioration at time of Substantial Completion and according to warranty requirements.

3.10 ROOFING SYSTEM INSTALLER'S WARRANTY

A. WHEREAS _____ of _____, herein called the "Roofing System Installer," has performed roofing and associated Work on the following Project:

1. Owner: <**Insert name of Owner**>.
2. Owner Address: <**Insert address**>.
3. Building Name/Type: <**Insert information**>.
4. Building Address: <**Insert address**>.
5. Area of Work: <**Insert information**>.
6. Warranty Period: Two years from date of Substantial Completion.
7. Date of Substantial Completion: _____.

B. AND WHEREAS Roofing System Installer has contracted (either directly with Owner or indirectly as a subcontractor) to warrant said Work against leaks and faulty or defective materials and workmanship for designated Warranty Period,

C. NOW THEREFORE Roofing System Installer hereby warrants, subject to terms and conditions herein set forth, that during Warranty Period, Roofing System Installer will, at Roofing System Installer's own cost and expense, make or cause to be made such repairs to or replacements of said Work as are necessary to correct faulty and defective work and as are necessary to maintain said Work in a watertight condition.

D. This Warranty is made subject to the following terms and conditions:

1. Specifically excluded from this Warranty are damages to Work and other parts of the building,

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and to building contents, caused by:

a. lightning;
b. peak gust wind speed exceeding <**Insert mph**>;
c. fire;
d. failure of roofing system substrate, including cracking, settlement, excessive deflection, deterioration, and decomposition;
e. faulty construction of parapet walls, copings, chimneys, skylights, vents, equipment supports, and other edge conditions and penetrations of the Work;
f. vapor condensation on bottom of roofing; and
g. activity on roofing by others, including construction contractors, maintenance personnel, other persons, and animals, whether authorized or unauthorized by Owner.

2. When Work has been damaged by any of foregoing causes, Warranty will be null and void until such damage has been repaired by Roofing System Installer and until cost and expense thereof have been paid by Owner or by another responsible party so designated.
3. Roofing System Installer is responsible for damage to Work covered by this Warranty but is not liable for consequential damages to building or building contents resulting from leaks or faults or defects of Work.
4. During Warranty Period, if Owner allows alteration of Work by anyone other than Roofing System Installer, including cutting, patching, and maintenance in connection with penetrations, attachment of other work, and positioning of anything on roof, this Warranty will become null and void on date of said alterations, but only to the extent said alterations affect Work covered by this Warranty. If Owner engages Roofing System Installer to perform said alterations, Warranty will not become null and void unless Roofing System Installer, before starting said Work, will have notified Owner in writing, showing reasonable cause for claim, that said alterations would likely damage or deteriorate Work, thereby reasonably justifying a limitation or termination of this Warranty.
5. During Warranty Period, if original use of roof is changed and it becomes used for, but was not originally specified for, a promenade, work deck, spray-cooled surface, flooded basin, or other use or service more severe than originally specified, this Warranty will become null and void on date of said change, but only to the extent said change affects Work covered by this Warranty.
6. Owner will promptly notify Roofing System Installer of observed, known, or suspected leaks, defects, or deterioration and afford reasonable opportunity for Roofing System Installer to inspect Work and to examine evidence of such leaks, defects, or deterioration.
7. This Warranty is recognized to be the only warranty of Roofing System Installer on said Work and will not operate to restrict or cut off Owner from other remedies and resources lawfully available to Owner in cases of roofing failure. Specifically, this Warranty will not operate to relieve Roofing System Installer of responsibility for performance of original Work in accordance with requirements of the Contract Documents, regardless of whether Contract was a contract directly with Owner or a subcontract with Owner's General Contractor.

E. IN WITNESS THEREOF, this instrument has been duly executed this _____ day of _____, _____.

1. Authorized Signature: _____.
2. Name: _____.
3. Title: _____.

END OF SECTION 07 54 23

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SECTION 07 62 00 - SHEET METAL FLASHING AND TRIM

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Sheet metal materials.
2. Underlayment.
3. Miscellaneous materials.
4. Roof-drainage sheet metal fabrications.
5. Sloped roof sheet metal fabrications.
6. Wall sheet metal fabrications.
7. Miscellaneous sheet metal fabrications.

B. Related Requirements:

1. Section 061000 "Rough Carpentry" for wood nailers, curbs, and blocking.
2. Section 077100 "Roof Specialties" for manufactured copings, roof-edge specialties, roof-edge drainage systems, reglets, and counterflashings.
3. Section 077200 "Roof Accessories" for set-on-type curbs, equipment supports, roof hatches, vents, and other manufactured roof accessory units.
4. Section 079513.13 "Interior Expansion Joint Cover Assemblies" for manufactured expansion-joint cover assemblies for interior floors, walls, and ceilings.
5. Section 079513.16 "Exterior Expansion Joint Cover Assemblies" for manufactured expansion-joint cover assemblies for exterior building walls, soffits, and parapets.

1.2 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1. Review construction schedule. Verify availability of materials, Installer's personnel, equipment, and facilities needed to make progress and avoid delays.
2. Review special roof details, roof drainage, roof-penetration flashing, equipment curbs, and condition of other construction that affect sheet metal flashing and trim.
3. Review requirements for insurance and certificates if applicable.
4. Review sheet metal flashing observation and repair procedures after flashing installation.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of specified product.

B. Shop Drawings: For sheet metal flashing and trim.

1. Plans, elevations, sections, and attachment details.
2. Fabrication and installation layouts, expansion-joint locations, and keyed details. Distinguish between shop- and field-assembled Work.
3. Identification of material, thickness, weight, and finish for each item and location in Project.
4. Details for forming, including profiles, shapes, seams, and dimensions.
5. Details for joining, supporting, and securing, including layout and spacing of fasteners, cleats, clips, and other attachments. Include pattern of seams.
6. Details of termination points and assemblies.
7. Details of expansion joints and expansion-joint covers, including showing direction of expansion and contraction from fixed points.
8. Details of roof-penetration flashing.
9. Details of edge conditions, including eaves, ridges, valleys, rakes, crickets, flashings, and counterflashings.
10. Details of special conditions.
11. Details of connections to adjoining work.

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12. Formed flashing and trim at scale of not less than **1-1/2 inches per 12 inches**.

C. Samples for Verification: Actual sample of finished products for each type of exposed finish for sheet metal and other metal accessories.

1. Sheet Metal Flashing and Trim: Manufacturers' standard size. Include finished seam with required profile. Include fasteners, cleats, clips, closures, and other attachments.
2. Anodized Aluminum Samples: Samples to show full range to be expected for each color required.

1.4 INFORMATIONAL SUBMITTALS

A. Certificates: For each type of coping and roof edge flashing that is FM Approvals approved.

B. Product Test Reports: For each product, for tests performed by a qualified testing agency.

C. Research Reports: For copings and roof edge flashing, from ICC-ES showing compliance with ANSI/SPRI/FM 4435/ES-1.

D. Qualification Statements: For fabricator.

E. Sample Warranties: For specified special warranties.

1.5 CLOSEOUT SUBMITTALS

A. Maintenance Data: For sheet metal flashing and trim, and its accessories.

1.6 QUALITY ASSURANCE

A. Fabricator Qualifications: Entity that employs skilled workers who custom fabricate sheet metal flashing and trim similar to that required for this Project and whose products have a record of successful in-service performance.

B. Installer Qualifications: Entity that employs a supervisor who is an NRCA ProCertified Roofing Foreman or installers who are NRCA ProCertified Architectural Metal Flashings and Accessories Installers.

C. For roof edge flashings and copings that are ANSI/SPRI/FM 4435/ES-1 tested and FM Approvals approved, shop is to be listed as able to fabricate required details as tested and approved.

1.7 MOCKUPS

A. Build mockups to verify selections made under Sample submittals, to demonstrate aesthetic effects, and to set quality standards for fabrication and installation.

1. Build mockup of typical roof edge, including fascia, approximately 10 ft. long, including supporting construction cleats, seams, attachments, underlayment, and accessories.
2. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Owner specifically approves such deviations by Change Order.
3. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.8 DELIVERY, STORAGE, AND HANDLING

A. Do not store sheet metal flashing and trim materials in contact with other materials that might cause staining, denting, or other surface damage.

1. Store sheet metal flashing and trim materials away from uncured concrete and masonry.
2. Protect stored sheet metal flashing and trim from contact with water.

B. Protect strippable protective covering on sheet metal flashing and trim from exposure to sunlight and high humidity, except to extent necessary for period of sheet metal flashing and trim installation.

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1.9 COORDINATION

A. Coordinate sheet metal flashing and trim layout and seams with sizes and locations of penetrations to be flashed, and joints and seams in adjacent materials.

B. Coordinate sheet metal flashing and trim installation with adjoining roofing and wall materials, joints, and seams to provide leakproof, secure, and noncorrosive installation.

1.10 WARRANTY

A. Special Warranty on Finishes: Manufacturer agrees to repair finish or replace sheet metal flashing and trim that shows evidence of deterioration of factory-applied finishes within specified warranty period.

1. Exposed Panel Finish: Deterioration includes, but is not limited to, the following:

a. Color fading more than 5 Delta E units when tested in accordance with ASTM D2244.
b. Chalking in excess of a No. 8 rating when tested in accordance with ASTM D4214.
c. Cracking, checking, peeling, or failure of paint to adhere to bare metal.

2. Finish Warranty Period: 20 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Sheet metal flashing and trim assemblies, including cleats, anchors, and fasteners, are to withstand wind loads, structural movement, thermally induced movement, and exposure to weather without failure due to defective manufacture, fabrication, installation, or other defects in construction. Completed sheet metal flashing and trim are not to rattle, leak, or loosen, and are to remain watertight.

B. Sheet Metal Standard for Flashing and Trim: Comply with NRCA's "The NRCA Roofing Manual: Architectural Metal Flashing, Condensation and Air Leakage Control, and Reroofing" and SMACNA's "Architectural Sheet Metal Manual" requirements for dimensions and profiles shown unless more stringent requirements are indicated.

C. SPRI Wind Design Standard: Manufacture and install roof edge flashings and copings tested in accordance with ANSI/SPRI/FM 4435/ES-1 and capable of resisting the following design pressure:

1. Design Pressure: As indicated on Drawings.

D. FM Approvals Listing: Manufacture and install roof edge flashings and copings that comply with requirements in FM Approvals 4471 as part of a roofing system and that are listed in FM Approvals' "Approval Guide" and approved for windstorm classification, Class 1A-105. Identify materials with name of fabricator and design approved by FM Approvals.

E. 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 SHEET METAL MATERIALS

A. Sheet Metal Materials, General: Protect mechanical and other finishes on exposed surfaces from damage by applying strippable, temporary protective film before shipping.

B. Metallic-Coated Steel Sheet : Zinc-coated (galvanized) steel sheet complying with minimum ASTM A653/A653M, **G90** coating designation, or aluminum-zinc alloy-coated steel sheet complying with minimum ASTM A792/A792M, **Class AZ50** coating designation; structural quality.

1. Nominal Thickness: 0.034 inch.
2. Surface: Smooth, flat.
3. Exposed Coil-Coated Finish: Prepainted by the coil-coating process to comply with ASTM A755/A755M.

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a. Three-Coat Fluoropolymer: Fluoropolymer finish containing not less than 70 percent PVDF resin by weight in both color coat and clear topcoat. Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions .

4. Color: As selected by Architect from manufacturer's full range.
5. Concealed Finish: Pretreat with manufacturer's standard white or light-colored acrylic or polyester backer finish, consisting of prime coat and wash coat with minimum total dry film thickness of **0.5 mil**.

C. Aluminum Sheet : ASTM B209/B209M, alloy as standard with manufacturer, with temper as required to suit forming operations and structural performance required.

1. Thickness: 0.032 inch.
2. Surface: Smooth, flat.
3. Exposed Coil-Coated Finish:

a. Three-Coat Fluoropolymer: AAMA 2605. Fluoropolymer finish containing not less than 70 percent PVDF resin by weight in both color coat and clear topcoat. Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions .

4. Color: As selected by Architect from manufacturer's full range.
5. Concealed Finish: Pretreat with manufacturer's standard white or light-colored acrylic or polyester backer finish, consisting of prime coat and wash coat with minimum total dry film thickness of **0.5 mil**.
6. Clear Anodic Finish, Coil Coated: AAMA 611, AA-M12C22A41, Class I, 0.018 mm or thicker.
7. Color Anodic Finish, Coil Coated: AAMA 611, AA-M12C22A42/A44, Class I, 0.018 mm or thicker.

a. Color: As selected by Architect from full range of industry colors and color densities.
b. Color Range: 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.

8. Factory Prime Coating: Where painting after installation is required, pretreat metal with white or light-colored, factory-applied, baked-on epoxy primer coat; minimum dry film thickness of **0.2 mil**.

D. Stainless Steel Sheet : ASTM A240/A240M, Type 304; dead soft, fully annealed.

1. Nominal Thickness: 0.0250 inch.
2. Surface: Smooth, flat.
3. Exterior Finish: ASTM A480/A480M, No. 2D (dull, cold rolled).

a. Surface Preparation: Remove tool and die marks and stretch lines, or blend into finish.
b. Polished Finishes: Grind and polish surfaces to produce uniform finish, free of cross scratches.

1) Run grain of directional finishes with long dimension of each piece.
2) When polishing is completed, passivate and rinse surfaces. Remove embedded foreign matter and leave surfaces chemically clean.

2.3 UNDERLAYMENT

A. Synthetic Underlayment: Laminated or reinforced, woven polyethylene or polypropylene, synthetic roofing underlayment; bitumen free; slip resistant; suitable for high temperatures over **220 deg F**; and complying with physical requirements of ASTM D226/D226M for Type I and Type II felts.

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

a. Atlas Molded Products, a division of Atlas Roofing Corporation
b. Intertape Polymer Group

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c. Kirsch Building Products

B. Self-Adhering, High-Temperature Sheet Underlayment: Provide self-adhering, cold-applied, sheet underlayment, specifically designed to withstand high metal temperatures beneath metal roofing. Provide primer when recommended by underlayment manufacturer.

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. ATAS International, Inc.
   b. Carlisle WIP Products; a brand of Carlisle Construction Materials
   c. GCP Applied Technologies Inc.
   d. Henry, a Carlisle Company (formerly Henry Company and Carlisle Coatings & Waterproofing Inc. brands)
   e. Owens Corning
   f. Polyglass U.S.A., Inc.
   g. Protecto Wrap Company
   h. SDP Advanced Polymer Products Inc.

2. Thickness: **30 mils** minimum.
3. Thermal Stability: Stable after testing at **240 deg F**; ASTM D1970/D1970M.
4. Low-Temperature Flexibility: Passes after testing at **minus 20 deg F** or lower; ASTM D1970/D1970M.

C. Felt Underlayment : ASTM D226/D226M, Type II (No. 30), asphalt-saturated organic felt; nonperforated.

D. Slip Sheet : Rosin-sized building paper, **3 lb/100 sq. ft.** minimum, of type required for application.

2.4 MISCELLANEOUS MATERIALS

A. Provide materials and types of fasteners , protective coatings, sealants, and other miscellaneous items as required for complete sheet metal flashing and trim installation and as recommended by manufacturer of primary sheet metal or manufactured item unless otherwise indicated.

B. Fasteners: Wood screws, annular threaded nails, self-tapping screws, self-locking rivets and bolts, and other suitable fasteners designed to withstand design loads and recommended by manufacturer of primary sheet metal or manufactured item.

1. General: Blind fasteners or self-drilling screws, gasketed, with hex-washer head.

   a. Exposed Fasteners: Heads matching color of sheet metal using plastic caps or factory-applied coating. Provide metal-backed EPDM or PVC sealing washers under heads of exposed fasteners bearing on weather side of metal.
   b. Blind Fasteners: High-strength aluminum or stainless steel rivets suitable for metal being fastened.
   c. Spikes and Ferrules: Same material as gutter; with spike with ferrule matching internal gutter width.

2. Fasteners for Zinc-Coated (Galvanized) or Aluminum-Zinc Alloy-Coated Steel Sheet: Series 300 stainless steel or hot-dip galvanized steel in accordance with ASTM A153/A153M or ASTM F2329/F2329M.
3. Fasteners for Aluminum Sheet: Aluminum or Series 300 stainless steel.
4. Fasteners for Stainless Steel Sheet: Series 300 stainless steel.
5. Fasteners for Copper, Zinc-Tin Alloy-Coated Copper, or Copper-Clad Stainless Steel Sheet: Copper, hardware bronze or passivated Series 300 stainless steel.
6. Fasteners for Zinc Sheet: Series 300 stainless steel or hot-dip galvanized steel in accordance with ASTM A153/A153M or ASTM F2329/F2329M.

C. Sealant Tape: Pressure-sensitive, 100 percent solids, polyisobutylene compound sealant tape with release-paper backing. Provide permanently elastic, nonsag, nontoxic, nonstaining tape **1/2 inch** wide and **1/8 inch** thick.

D. Elastomeric Sealant: ASTM C920, elastomeric polymer sealant; of type, grade, class, and use

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classifications required to seal joints in sheet metal flashing and trim and remain watertight.

1. Material: Silicone.

E. Butyl Sealant: ASTM C1311, single-component, solvent-release butyl rubber sealant; polyisobutylene plasticized; heavy bodied for hooked-type expansion joints with limited movement.

F. Epoxy Seam Sealer: Two-part, noncorrosive, aluminum seam-cementing compound, recommended by aluminum manufacturer for exterior nonmoving joints, including riveted joints.

G. Bituminous Coating: Cold-applied asphalt emulsion in accordance with ASTM D1187/D1187M.

H. Asphalt Roofing Cement: ASTM D4586/D4586M, asbestos free, of consistency required for application.

I. Reglets: Units of type, material, and profile required, formed to provide secure interlocking of separate reglet and counterflashing pieces, and compatible with flashing indicated with factory-mitered and - welded corners and junctions.

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. Cheney Flashing Company
   b. Fry Reglet Corporation
   c. Heckmann Building Products, Inc.
   d. Hohmann & Barnard, Inc
   e. Keystone Flashing Company, Inc
   f. Metal-Era, Inc.; a Carlisle Company
   g. OMG Roofing Products; a Division of OMG, Inc.

2. Material: Stainless steel, 0.0188 inch thick.
3. Surface-Mounted Type: Provide with slotted holes for fastening to substrate, with neoprene or other suitable weatherproofing washers, and with channel for sealant at top edge.
4. Stucco Type: Provide with upturned fastening flange and extension leg of length to match thickness of applied finish materials.
5. Concrete Type: Provide temporary closure tape to keep reglet free of concrete materials, special fasteners for attaching reglet to concrete forms, and guides to ensure alignment of reglet section ends.
6. Masonry Type: Provide with offset top flange for embedment in masonry mortar joint.
7. Accessories:

   a. Flexible-Flashing Retainer: Provide resilient plastic or rubber accessory to secure flexible flashing in reglet where clearance does not permit use of standard metal counterflashing or where Drawings show reglet without metal counterflashing.
   b. Counterflashing Wind-Restraint Clips: Provide clips to be installed before counterflashing to prevent wind uplift of counterflashing's lower edge.

8. Finish: With manufacturer's standard color coating.

2.5 FABRICATION, GENERAL

A. Custom fabricate sheet metal flashing and trim to comply with details indicated and recommendations in cited sheet metal standard that apply to design, dimensions, geometry, metal thickness, and other characteristics of item required.

1. Fabricate sheet metal flashing and trim in shop to greatest extent possible.
2. Fabricate sheet metal flashing and trim in thickness or weight needed to comply with performance requirements, but not less than that specified for each application and metal.
3. Verify shapes and dimensions of surfaces to be covered and obtain field measurements for accurate fit before shop fabrication.
4. Form sheet metal flashing and trim to fit substrates without excessive oil-canning, buckling, and tool marks; true to line, levels, and slopes; and with exposed edges folded back to form hems.
5. Conceal fasteners and expansion provisions where possible. Do not use exposed fasteners on faces exposed to view.

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B. Fabrication Tolerances:

1. Fabricate sheet metal flashing and trim that is capable of installation to a tolerance of **1/4 inch in 20 ft.** on slope and location lines indicated on Drawings and within **1/8-inch** offset of adjoining faces and of alignment of matching profiles.
2. Fabricate sheet metal flashing and trim that is capable of installation to tolerances specified.

C. Expansion Provisions: Form metal for thermal expansion of exposed flashing and trim.

1. Form expansion joints of intermeshing hooked flanges, not less than **1 inch** deep, filled with butyl sealant concealed within joints.
2. Use lapped expansion joints only where indicated on Drawings.

D. Sealant Joints: Where movable, nonexpansion-type joints are required, form metal in accordance with cited sheet metal standard to provide for proper installation of elastomeric sealant.

E. Fabricate cleats and attachment devices from same material as accessory being anchored or from compatible, noncorrosive metal.

F. Fabricate cleats and attachment devices of sizes as recommended by cited sheet metal standard and by FM Global Property Loss Prevention Data Sheet 1-49 for application, but not less than thickness of metal being secured.

G. Seams:

1. Fabricate nonmoving seams with flat-lock seams. Tin edges to be seamed, form seams, and solder.
2. Fabricate nonmoving seams with flat-lock seams. Form seams and seal with elastomeric sealant unless otherwise recommended by sealant manufacturer for intended use. Rivet joints where necessary for strength.
3. Seams for Aluminum: Fabricate nonmoving seams with flat-lock seams. Form seams and seal with epoxy seam sealer. Rivet joints where necessary for strength.

H. Do not use graphite pencils to mark metal surfaces.

2.6 SLOPED ROOF SHEET METAL FABRICATIONS

A. Low-Sloped Roof Sheet Metal Fabrications:

1. Roof Edge Flashing (Gravel Stop) and Fascia Cap:

a. Fabricate in minimum **96-inch-** long, but not exceeding **12 ft.** long sections. Furnish with **6-inch-** wide, joint cover plates. Shop fabricate interior and exterior corners.
b. Joint Style: Butted with expansion space and 6-inch- wide, concealed backup plate.
c. Scuppers: Fabricate with scuppers spaced 10 ft. apart, to dimensions required with **4-inch-** wide flanges and base extending **4 inches** beyond cant or tapered strip into field of roof. Fasten gravel guard angles to base of scupper.
d. Fabricate from the following materials:

1) Aluminum-Zinc Alloy-Coated Steel: 0.028 inch thick.
2) Aluminum: 0.050 inch thick.

2. Copings:

a. Fabricate in minimum **96-inch-** long, but not exceeding **12 ft.** long, sections. Fabricate joint plates of same thickness as copings. Furnish with continuous cleats to support edge of external leg and interior leg. Miter corners, fasten and seal watertight.
b. Joint Style: Butted with expansion space and 6-inch- wide, concealed backup plate.
c. Fabricate from the following materials:

1) Aluminum-Zinc Alloy-Coated Steel: 0.040 inch thick.
2) Aluminum: 0.050 inch thick.

3. Base Flashing:

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a. General: Shop fabricate interior and exterior corners. Fabricate from the following materials:

1) Aluminum-Zinc Alloy-Coated Steel: 0.028 inch thick.
2) Aluminum: 0.040 inch thick.

4. Counterflashing:

a. General: Shop fabricate interior and exterior corners. Fabricate from the following materials:

1) Aluminum-Zinc Alloy-Coated Steel: 0.022 inch thick.
2) Aluminum: 0.032 inch thick.

5. Flashing Receivers: Fabricate from the following materials:

a. Aluminum-Zinc Alloy-Coated Steel: 0.022 inch thick.
b. Aluminum: 0.032 inch thick.

6. Roof-Penetration Flashing: Fabricate from the following materials:

a. Aluminum-Zinc Alloy-Coated Steel: 0.028 inch thick.
b. Stainless Steel: 0.0188 inch thick.

7. Roof-Drain Flashing: Fabricate from the following materials:

a. Stainless Steel: 0.0156 inch thick.

2.7 WALL SHEET METAL FABRICATIONS

A. Through-Wall Flashing:

1. General: Fabricate continuous flashings in minimum **96-inch-** long, but not exceeding **12 ft.** long, sections, under copings, and at shelf angles. Fabricate discontinuous lintel, sill, and similar flashings to extend **6 inches** beyond each side of wall openings; and form with **2-inch-** high, end dams. Fabricate from the following materials:

a. Stainless Steel: 0.0156 inch thick.

B. Opening Flashings in Frame Construction:

1. General: Fabricate head, sill, jamb, and similar flashings to extend 4 inches beyond wall openings. Form head and sill flashing with **2-inch-** high, end dams. Fabricate from the following materials:

a. Aluminum-Zinc Alloy-Coated Steel: 0.022 inch thick.
b. Aluminum: 0.032 inch thick.

2.8 MISCELLANEOUS SHEET METAL FABRICATIONS

A. Equipment Support Flashing: Fabricate from the following materials:

1. Galvanized Steel: 0.028 inch thick.
2. Aluminum-Zinc Alloy-Coated Steel: 0.028 inch thick.
3. Stainless Steel: 0.0188 inch thick.

B. Overhead-Piping Safety Pans: Fabricate from the following materials:

1. Galvanized Steel: 0.040 inch thick.
2. Aluminum-Zinc Alloy-Coated Steel: 0.040 inch thick.
3. Stainless Steel: 0.0250 inch thick.

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PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances, substrates, and other conditions affecting performance of the Work.

1. Verify compliance with requirements for installation tolerances of substrates.
2. Verify that substrate is sound, dry, smooth, clean, sloped for drainage, and securely anchored.
3. Verify that air- or water-resistant barriers have been installed over substrate to prevent air infiltration or water penetration.

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

3.2 INSTALLATION OF UNDERLAYMENT

A. Synthetic Underlayment: Install synthetic underlayment, wrinkle free, in accordance with manufacturers' written instructions, and using adhesive where possible to minimize use of mechanical fasteners under sheet metal.

1. Lap horizontal joints not less than **4 inches**.
2. Lap end joints not less than **12 inches**.

B. Self-Adhering, High-Temperature Sheet Underlayment:

1. Install self-adhering, high-temperature sheet underlayment; wrinkle free.
2. Prime substrate if recommended by underlayment manufacturer.
3. Comply with temperature restrictions of underlayment manufacturer for installation; use primer for installing underlayment at low temperatures.
4. Apply in shingle fashion to shed water, with end laps of not less than **6 inches** staggered **24 inches** between courses.
5. Overlap side edges not less than **3-1/2 inches**. Roll laps and edges with roller.
6. Roll laps and edges with roller.
7. Cover underlayment within 14 days.

C. Felt Underlayment: Install felt underlayment, wrinkle free, using adhesive to minimize use of mechanical fasteners under sheet metal flashing and trim.

1. Install in shingle fashion to shed water.
2. Lap joints not less than **2 inches**.

D. Slip Sheet: Install slip sheet, wrinkle free, over underlayment before installing sheet metal flashing and trim.

1. Install in shingle fashion to shed water.
2. Lapp joints not less than **4 inches**.

3.3 INSTALLATION OF SHEET METAL FLASHING AND TRIM, GENERAL

A. Install sheet metal flashing and trim to comply with details indicated and recommendations of cited sheet metal standard that apply to installation characteristics required unless otherwise indicated on Drawings.

1. Install fasteners , protective coatings, separators, sealants, and other miscellaneous items as required to complete sheet metal flashing and trim system.
2. Install sheet metal flashing and trim true to line, levels, and slopes. Provide uniform, neat seams with minimum exposure of sealant.
3. Anchor sheet metal flashing and trim and other components of the Work securely in place, with provisions for thermal and structural movement.
4. Install sheet metal flashing and trim to fit substrates and to result in watertight performance.
5. Install continuous cleats with fasteners spaced not more than **12 inches** o.c.
6. Space individual cleats not more than **12 inches** apart. Attach each cleat with at least two fasteners. Bend tabs over fasteners.

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7. Install exposed sheet metal flashing and trim with limited oil-canning, and free of buckling and tool marks.
8. Do not field cut sheet metal flashing and trim by torch.
9. Do not use graphite pencils to mark metal surfaces.

B. Metal Protection: Where dissimilar metals contact each other, or where metal contacts pressure-treated wood or other corrosive substrates, protect against galvanic action or corrosion by painting contact surfaces with bituminous coating or by other permanent separation as recommended by sheet metal manufacturer or cited sheet metal standard.

1. Coat concealed side of uncoated-aluminum and stainless steel sheet metal flashing and trim with bituminous coating where flashing and trim contact wood, ferrous metal, or cementitious construction.
2. Underlayment: Where installing sheet metal flashing and trim directly on cementitious or wood substrates, install underlayment and cover with slip sheet.

C. Expansion Provisions: Provide for thermal expansion of exposed flashing and trim.

1. Space movement joints at maximum of 10 ft. with no joints within **24 inches** of corner or intersection.
2. Form expansion joints of intermeshing hooked flanges, not less than **1 inch** deep, filled with sealant concealed within joints.
3. Use lapped expansion joints only where indicated on Drawings.

D. Fasteners: Use fastener sizes that penetrate substrate not less than recommended by fastener manufacturer to achieve maximum pull-out resistance.

E. Conceal fasteners and expansion provisions where possible in exposed work and locate to minimize possibility of leakage. Cover and seal fasteners and anchors as required for a tight installation.

F. Seal joints as required for watertight construction.

1. Use sealant-filled joints unless otherwise indicated.

a. Embed hooked flanges of joint members not less than **1 inch** into sealant.
b. Form joints to completely conceal sealant.
c. When ambient temperature at time of installation is between **40 and 70 deg F**, set joint members for 50 percent movement each way.
d. Adjust setting proportionately for installation at higher ambient temperatures.

1) Do not install sealant-type joints at temperatures below **40 deg F**.

2. Prepare joints and apply sealants to comply with requirements in Section 079200 "Joint Sealants."

G. Soldered Joints: Clean surfaces to be soldered, removing oils and foreign matter.

1. Pretin edges of sheets with solder to width of **1-1/2 inches**; however, reduce pretinning where pretinned surface would show in completed Work.
2. Do not solder metallic-coated steel and aluminum sheet.
3. Do not pretin zinc-tin alloy-coated copper.
4. Do not use torches for soldering.
5. Heat surfaces to receive solder, and flow solder into joint.

a. Fill joint completely.
b. Completely remove flux and spatter from exposed surfaces.

6. Stainless Steel Soldering:

a. Tin edges of uncoated sheets, using solder for stainless steel and acid flux.
b. Promptly remove acid-flux residue from metal after tinning and soldering.
c. Comply with solder manufacturer's recommended methods for cleaning and neutralization.

7. Copper Soldering: Tin edges of uncoated sheets, using solder for copper.
8. Copper-Clad Stainless Steel Soldering: Tin edges of uncoated sheets, using solder for copper-

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clad stainless steel.

H. Rivets: Rivet joints in uncoated aluminum zinc where necessary for strength.

3.4 INSTALLATION OF ROOF-DRAINAGE SHEET METAL FABRICATIONS

A. Install sheet metal roof-drainage items to produce complete roof-drainage system in accordance with cited sheet metal standard unless otherwise indicated. Coordinate installation of roof perimeter flashing with installation of roof-drainage system.

B. Hanging Gutters:

1. Join sections with joints sealed with sealant.
2. Provide for thermal expansion.
3. Attach gutters at eave or fascia to firmly anchor them in position.
4. Provide end closures and seal watertight with sealant.
5. Slope to downspouts.
6. Fasten gutter spacers to front and back of gutter.
7. Anchor and loosely lock back edge of gutter to continuous cleat.
8. Anchor back of gutter that extends onto roof deck with cleats spaced not more than 24 inches apart.
9. Anchor gutter with gutter brackets spaced not more than 30 inches apart to roof deck unless otherwise indicated, and loosely lock to front gutter bead.
10. Anchor gutter with spikes and ferrules spaced not more than 30 inches apart.
11. Install gutter with expansion joints at locations indicated on Drawings, but not exceeding, 50 ft. apart. Install expansion-joint caps.

C. Downspouts:

1. Join sections with **1-1/2-inch** telescoping joints.
2. Provide hangers with fasteners designed to hold downspouts securely to walls.
3. Locate hangers at top and bottom and at approximately **60 inches** o.c.
4. Provide elbows at base of downspout to direct water away from building.
5. Connect downspouts to underground drainage system.

D. Conductor Heads: Anchor securely to wall, with elevation of conductor head rim at minimum of **1 inch** below scupper or gutter discharge.

E. Splash Pans:

1. Install where downspouts discharge on low-slope roofs.
2. Set in elastomeric sealant compatible with the substrate.

F. Expansion-Joint Covers: Install expansion-joint covers at locations and of configuration indicated on Drawings. Lap joints minimum of **4 inches** in direction of water flow.

3.5 INSTALLATION OF SLOPED ROOF SHEET METAL FABRICATIONS

A. Install sheet metal flashing and trim to comply with performance requirements , sheet metal manufacturer's written installation instructions, and cited sheet metal standard.

1. Provide concealed fasteners where possible, and set units true to line, levels, and slopes.
2. Install work with laps, joints, and seams that are permanently watertight and weather resistant.

B. Roof Edge Flashing:

1. Install roof edge flashings in accordance with ANSI/SPRI/FM 4435/ES-1.
2. Anchor to resist uplift and outward forces in accordance with recommendations in cited sheet metal standard unless otherwise indicated. Interlock bottom edge of roof edge flashing with continuous cleat anchored to substrate at staggered 3-inch centers.
3. Anchor to resist uplift and outward forces in accordance with recommendations in FM Global Property Loss Prevention Data Sheet 1-49 for FM Approvals' listing for required windstorm classification.

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C. Copings:

1. Install copings in accordance with ANSI/SPRI/FM 4435/ES-1.
2. Anchor to resist uplift and outward forces in accordance with recommendations in cited sheet metal standard unless otherwise indicated.

   a. Interlock exterior bottom edge of coping with continuous cleat anchored to substrate at 24-inch centers.
   b. Anchor interior leg of coping with washers and screw fasteners through slotted holes at 24-inch centers.

3. Anchor to resist uplift and outward forces in accordance with recommendations in FM Global Property Loss Prevention Data Sheet 1-49 for specified FM Approvals' listing for required windstorm classification.

D. Pipe or Post Counterflashing: Install counterflashing umbrella with close-fitting collar with top edge flared for elastomeric sealant, extending minimum of **4 inches** over base flashing. Install stainless steel draw band and tighten.

E. Counterflashing: Coordinate installation of counterflashing with installation of base flashing.

1. Insert counterflashing in reglets or receivers and fit tightly to base flashing.
2. Extend counterflashing **4 inches** over base flashing.
3. Lap counterflashing joints minimum of **4 inches**.
4. Secure in waterproof manner by means of snap-in installation and sealant or lead wedges and sealant unless otherwise indicated.

F. Roof-Penetration Flashing: Coordinate installation of roof-penetration flashing with installation of roofing and other items penetrating roof. Seal with elastomeric sealant and clamp flashing to pipes that penetrate roof.

3.6 INSTALLATION OF WALL SHEET METAL FABRICATIONS

A. Install sheet metal wall flashing to intercept and exclude penetrating moisture in accordance with cited sheet metal standard unless otherwise indicated. Coordinate installation of wall flashing with installation of wall-opening components such as windows, doors, and louvers.

B. Opening Flashings in Frame Construction: Install continuous head, sill, jamb, and similar flashings to extend 4 inches beyond wall openings.

3.7 INSTALLATION OF MISCELLANEOUS SHEET METAL FABRICATIONS

A. Equipment Support Flashing:

1. Coordinate installation of equipment support flashing with installation of roofing and equipment.
2. Weld or seal flashing with elastomeric sealant to equipment support member.

B. Overhead-Piping Safety Pans:

1. Suspend pans from structure above, independent of other overhead items such as equipment, piping, and conduit, unless otherwise indicated on Drawings.
2. Pipe and install drain line to plumbing waste or drainage system.

3.8 INSTALLATION TOLERANCES

A. Shim and align sheet metal flashing and trim within installed tolerance of **1/4 inch in 20 ft.** on slope and location lines indicated on Drawings and within **1/8-inch** offset of adjoining faces and of alignment of matching profiles.

3.9 CLEANING

A. Clean and neutralize flux materials. Clean off excess solder.

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B. Clean off excess sealants.

3.10 PROTECTION

A. Remove temporary protective coverings and strippable films as sheet metal flashing and trim are installed unless otherwise indicated in manufacturer's written installation instructions.

B. On completion of sheet metal flashing and trim installation, remove unused materials and clean finished surfaces as recommended in writing by sheet metal flashing and trim manufacturer.

C. Maintain sheet metal flashing and trim in clean condition during construction.

D. 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, as determined by Architect.

END OF SECTION 07 62 00

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SECTION 07 71 00 - ROOF SPECIALTIES

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Copings.
2. Roof-edge specialties.
3. Roof-edge drainage systems.
4. Reglets and counterflashings.
5. Underlayment.

B. Related Requirements:

1. Section 033000 "Cast-in-Place Concrete" for installing embedded reglets.
2. Section 042000 "Unit Masonry" for installing embedded reglets and for masonry through-wall flashing with receiver for counterflashing.
3. Section 055000 "Metal Fabrications" for downspout guards and downspout boots.
4. Section 061000 "Rough Carpentry" for wood nailers, curbs, and blocking.
5. Section 076200 "Sheet Metal Flashing and Trim" for custom- and site-fabricated, sheet metal flashing and trim.
6. Section 077129 "Manufactured Roof Expansion Joints" for manufactured roof expansion-joint cover assemblies.
7. Section 077200 "Roof Accessories" for manufactured roof curbs, equipment supports, roof hatches, vents, and other manufactured roof accessory units.
8. Section 077253 "Snow Guards" for prefabricated devices designed to hold snow on the roof surface, allowing it to melt and drain off slowly.
9. Section 079200 "Joint Sealants" for field-applied sealants between roof specialties and adjacent materials.
10. Section 099113 "Exterior Painting" for field painting of roof specialties.
11. Section 099114 "Exterior Painting (MPI Standards)" for field painting of roof specialties.

1.2 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1. Meet with Owner, Architect, Owner's insurer if applicable, roofing-system testing and inspecting agency representative, roofing Installer, roofing-system manufacturer's representative, Installer, structural-support Installer, and installers whose work interfaces with or affects roof specialties, including installers of roofing materials and accessories.
2. Examine substrate conditions for compliance with requirements, including flatness and attachment to structural members.
3. Review special roof details, roof drainage, and condition of other construction that will affect roof specialties.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of specified product.

1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes.

B. Shop Drawings: For roof specialties.

1. Plans, expansion-joint locations, keyed details, and attachments to other work. Distinguish between factory pre manufactured- and field-assembled installation.
2. Details for expansion and contraction; locations of expansion joints, including direction of expansion and contraction.

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3. Indicate profile and pattern of seams and layout of fasteners, cleats, clips, and other attachments.
4. Details of termination points and assemblies, including fixed points.
5. Details of special conditions.

C. Samples for Initial Selection: For each type of roof specialty indicated with factory-applied color finishes.

D. Samples for Verification:

1. Include Samples of each type of roof specialty to verify finish and color selection, in manufacturer's standard sizes.
2. Include copings made from **12-inch** lengths of full-size components in specified material, and including fasteners, cover joints, accessories, and attachments.

1.4 INFORMATIONAL SUBMITTALS

A. Product Certificates: For each type of roof specialty copings and roof-edge specialties that is FM Approvals approved.

B. Product Test Reports: For copings and roof-edge specialties, for tests performed by a qualified testing agency.

C. Research Reports: For copings and roof-edge specialties, from ICC-ES showing compliance with ANSI/SPRI/FM 4435/ES-1.

D. Qualification Statements: For manufacturer.

E. Sample Warranties: For specified special warranties.

1.5 CLOSEOUT SUBMITTALS

A. Maintenance Data: For roof specialties.

1.6 QUALITY ASSURANCE

A. Manufacturer Qualifications: A qualified manufacturer offering products that are FM Approvals listed for specified class.

1.7 MOCKUPS

A. Build mockups to verify selections made under Sample submittals, to demonstrate aesthetic effects, and to set quality standards for fabrication and installation.

1. Build mockup of typical roof edge, including fascia gutter and downspout, approximately 10 ft. long, including supporting construction, seams, attachments, underlayment, and accessories.
2. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Owner specifically approves such deviations by Change Order.
3. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.8 DELIVERY, STORAGE, AND HANDLING

A. Do not store roof specialties in contact with other materials that might cause staining, denting, or other surface damage. Store roof specialties away from uncured concrete and masonry.

B. Protect strippable protective covering on roof specialties from exposure to sunlight and high humidity, except to extent necessary for the period of roof-specialty installation.

1.9 FIELD CONDITIONS

A. Field Measurements: Verify profiles and tolerances of roof-specialty substrates by field measurements

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before fabrication, and indicate measurements on Shop Drawings.

1.10 COORDINATION

A. Coordinate roof specialties with roofing system, exterior wall system, air barrier, flashing, trim, and construction of parapets, roof deck, roof and wall panels, and other adjoining work to provide a leakproof, weathertight, secure, and noncorrosive installation.

1. Performance Coordination: Coordinate with the Work of roofing and exterior wall Sections to ensure that roof specialties provided under the Work of this Section meet or exceed specified roofing and exterior wall design performance requirements.

B. Confirm and coordinate compatibility of materials and comply with warranty requirements of roofing system manufacturer.

C. Coordinate roof specialties layout and seams with sizes and locations of joints and seams in adjacent materials.

1.11 WARRANTY

A. Roofing-System Warranty: Roof specialties are included in warranty provisions in Section 07 54 23 " THERMOPLASTIC-POLYOLEFIN (TPO) ROOFING."

B. Special Warranty on Painted Finishes: Manufacturer agrees to repair finishes or replace roof specialties 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 5 Delta E units when tested in accordance with ASTM D2244.
b. Chalking in excess of a No. 8 rating when tested in accordance with ASTM D4214.
c. Cracking, checking, peeling, or failure of paint to adhere to bare metal.

2. Finish Warranty Period: 20 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. General Performance: Roof specialties to withstand exposure to weather and resist thermally induced movement without failure, rattling, leaking, or fastener disengagement due to defective manufacture, fabrication, installation, or other defects in construction.

B. FM Approvals' Listing: Manufacture and install copings that are listed in FM Approvals' "Approval Guide" and approved for windstorm classification, Class 1-105. Identify materials with FM Approvals' markings.

C. SPRI Wind Design Standard: Manufacture and install copings tested in accordance with ANSI/SPRI/FM 4435/ES and capable of resisting the following design pressures:

1. Design Pressure: As indicated on Drawings.

D. Thermal Movements: Allow for thermal movements from ambient and surface temperature changes to prevent buckling, opening of joints, hole elongation, overstressing of components, failure of joint sealants, failure of connections, and other detrimental effects. Provide clips that resist rotation and avoid shear stress as a result of thermal movements. Base calculations on surface temperatures of materials due to both solar heat gain and nighttime-sky heat loss.

1. Temperature Change: 120 deg F, ambient; 180 deg F, material surfaces.

2.2 COPINGS

A. Metal Copings: Manufactured coping system consisting of metal coping cap with concealed

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anchorage; including corner units, end cap units, and concealed splice plates with finish matching coping caps.

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. Architectural Products Company
    b. ATAS International, Inc.
    c. Berridge Manufacturing Company
    d. Carlisle Companies
    e. Castle Metal Products
    f. Cheney Flashing Company
    g. Drexel Metals Corp. – Carlisle Construction Materials
    h. Englert, Inc.
    i. EXCEPTIONAL Metals
    j. FlashCo Manufacturing Inc.
    k. Hickman; a Carlisle Company
    l. Merchant & Evans Inc.
    m. Metal-Era, Inc.; a Carlisle Company
    n. OMG Roofing Products; a Division of OMG, Inc.
    o. SAF (Southern Aluminum Finishing Company, Inc.)

2. Maximum Section Length: 12 ft..
3. Metallic-Coated Steel Coping Caps: Zinc-coated (galvanized) or aluminum-zinc alloy-coated steel sheet, nominal 0.034-inch thickness.

    a. Surface: Smooth, flat finish.
    b. Finish: Three-coat fluoropolymer.
    c. Color: As selected by Architect from manufacturer's full range.

4. Formed Aluminum Coping Caps: Aluminum sheet, 0.050 inch thick.

    a. Surface: Smooth, flat finish.
    b. Finish: Three-coat fluoropolymer.
    c. Color: As selected by Architect from manufacturer's full range.

5. Corners: Factory mitered and mechanically clinched and sealed watertight.
6. Special Fabrications: Two-way sloped coping cap.
7. Coping-Cap Attachment Method: Snap-on or face leg hooked to continuous cleat with back leg fastener exposed, fabricated from coping-cap material.

    a. Snap-on Coping Anchor Plates: Concealed, galvanized-steel sheet, **12 inches** wide, with integral cleats.
    b. Face-Leg Cleats: Concealed, continuous galvanized-steel sheet.

2.3 ROOF-EDGE SPECIALTIES

A. Canted Roof-Edge Fascia and Gravel Stop: Manufactured, two-piece, roof-edge fascia consisting of a metal fascia and a continuous formed galvanized-steel sheet cant, **0.028 inch** thick, minimum, with extended vertical leg terminating in a drip-edge cleat. Provide matching corner units.

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. Architectural Products Company
    b. ATAS International, Inc.
    c. Berridge Manufacturing Company
    d. Carlisle Companies
    e. Castle Metal Products
    f. Cheney Flashing Company
    g. Drexel Metals Corp. – Carlisle Construction Materials
    h. Englert, Inc.
    i. FlashCo Manufacturing Inc.
    j. Merchant & Evans Inc.

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k. Metal-Era, Inc.; a Carlisle Company
l. OMG Roofing Products; a Division of OMG, Inc.
m. SAF (Southern Aluminum Finishing Company, Inc.)

2. Fascia Cover Type: Compression-clamped.
3. Maximum Section Length: 12 ft..
4. Metallic-Coated Steel Fascia Covers: Zinc-coated (galvanized) or aluminum-zinc alloy-coated steel sheet, nominal 0.034-inch thickness.

   a. Surface: Smooth, flat finish.
   b. Finish: Three-coat fluoropolymer.
   c. Color: As selected by Architect from manufacturer's full range.

5. Formed Aluminum Fascia Covers: Aluminum sheet, 0.050 inch thick.

   a. Surface: Smooth, flat finish.
   b. Finish: Three-coat fluoropolymer.
   c. Color: As selected by Architect from manufacturer's full range.

6. Extruded-Aluminum Fascia Covers: Extruded aluminum, 0.080 inch thick.

   a. Finish: Three-coat fluoropolymer.
   b. Color: As selected by Architect from manufacturer's full range.

7. Corners: Factory mitered and mechanically clinched and sealed watertight.
8. Splice Plates: Concealed, of same material, finish, and shape as fascia cover.
9. Fascia Accessories: Fascia extenders with continuous hold-down cleats.

B. Roof-Edge Fascia: Manufactured, two-piece, roof-edge fascia consisting of snap-on metal fascia cover and a continuous metal receiver with integral drip-edge cleat to engage fascia cover and secure single-ply roof membrane. Provide matching corner units.

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. ATAS International, Inc.
   b. Berridge Manufacturing Company
   c. Carlisle Companies
   d. Drexel Metals Corp. – Carlisle Construction Materials
   e. Englert, Inc.
   f. EXCEPTIONAL Metals
   g. Fabral
   h. FlashCo Manufacturing Inc.
   i. Hickman; a Carlisle Company
   j. Metal-Era, Inc.; a Carlisle Company
   k. OMG Roofing Products; a Division of OMG, Inc.

2. Maximum Section Length: 12 ft..
3. Metallic-Coated Steel Fascia Covers: Zinc-coated (galvanized) or aluminum-zinc alloy-coated steel sheet, nominal 0.034-inch thickness.

   a. Surface: Smooth, flat finish.
   b. Finish: Three-coat fluoropolymer.
   c. Color: As selected by Architect from manufacturer's full range.

4. Formed Aluminum Fascia Covers: Aluminum sheet, 0.050 inch thick.

   a. Surface: Smooth, flat finish.
   b. Finish: Three-coat fluoropolymer.
   c. Color: As selected by Architect from manufacturer's full range.

5. Corners: Factory mitered and mechanically clinched and sealed watertight.
6. Splice Plates: Concealed, of same material, finish, and shape as fascia cover.
7. Receiver: Galvanized-steel sheet, nominal 0.040-inch thickness.
8. Fascia Accessories: Fascia extenders with continuous hold-down cleats.

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C. One-Piece Gravel Stops: Manufactured, one-piece, metal gravel stop with a horizontal flange and vertical leg fascia terminating in a drip edge, and concealed splice plates of same material, finish, and shape as gravel stop. Provide matching corner units.

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. Berridge Manufacturing Company
   b. Carlisle Companies
   c. Castle Metal Products
   d. Cheney Flashing Company
   e. Drexel Metals Corp. – Carlisle Construction Materials
   f. OMG Roofing Products; a Division of OMG, Inc.
   g. SAF (Southern Aluminum Finishing Company, Inc.)

2. Maximum Section Length: 12 ft..
3. Metallic-Coated Steel Gravel Stops: Zinc-coated (galvanized) or aluminum-zinc alloy-coated steel sheet, nominal 0.034-inch thickness.

   a. Surface: Smooth, flat finish.
   b. Finish: Three-coat fluoropolymer.
   c. Color: As selected by Architect from manufacturer's full range.

4. Formed Aluminum Gravel Stops: Aluminum sheet, 0.050 inch thick.

   a. Surface: Smooth, flat finish.
   b. Finish: Three-coat fluoropolymer.
   c. Color: As selected by Architect from manufacturer's full range.

5. Extruded-Aluminum Gravel Stops: Extruded aluminum, 0.080 inch thick.

   a. Finish: Three-coat fluoropolymer.
   b. Color: As selected by Architect from manufacturer's full range.

6. Corners: Factory mitered and mechanically clinched and sealed watertight.
7. Accessories: Fascia extenders with continuous hold-down cleats.

2.4 ROOF-EDGE DRAINAGE SYSTEMS

A. Roof-Edge Drainage System:

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. Architectural Products Company
   b. ATAS International, Inc.
   c. Berger; division of OmniMax International, Inc.
   d. Carlisle Companies
   e. Castle Metal Products
   f. Cheney Flashing Company
   g. CopperCraft by Fabral
   h. Drexel Metals Corp. – Carlisle Construction Materials
   i. EXCEPTIONAL Metals
   j. Hickman; a Carlisle Company
   k. Merchant & Evans Inc.
   l. Metal-Era, Inc.; a Carlisle Company
   m. OMG Roofing Products; a Division of OMG, Inc.
   n. Roof Drainage Components & Accessories
   o. SAF (Southern Aluminum Finishing Company, Inc.)

2. Gutters: Manufactured in uniform section lengths not exceeding 12 ft., with matching corner units, ends, outlet tubes, and other accessories. Elevate back edge at least **1 inch** above front edge. Furnish flat-stock gutter straps, gutter brackets, expansion joints, and expansion-joint covers fabricated from same metal as gutters.

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a. Metallic-Coated Steel Sheet: Nominal 0.034-inch thickness.
b. Formed Aluminum Sheet: 0.050 inch thick.
c. Gutter Profile: Style A Style B Style F in accordance with SMACNA's "Architectural Sheet Metal Manual."
d. Applied Fascia Cover (Concealed Gutter): Exposed, formed aluminum, 0.040 inch thick, with factory-mitered corners, ends, and concealed splice joints.
e. Corners: Factory mitered and mechanically clinched and sealed watertight.
f. Gutter Supports: Manufacturer's standard supports as selected by Architect with finish matching the gutters.

3. Downspouts: Corrugated rectangular complete with machine-crimped elbows, manufactured from the following exposed metal. Furnish with metal hangers, from same material as downspouts, and anchors.

a. Metallic-Coated Steel Sheet: Nominal 0.034-inch thickness.
b. Formed Aluminum Sheet: 0.040 inch thick.
c. Extruded Aluminum: 0.125 inch thick.
d. Size: As indicated on Drawings.

4. Parapet Scuppers: Manufactured with closure flange trim to exterior, **4-inch-** wide wall flanges to interior, and base extending **4 inches** beyond cant or tapered strip into field of roof. Fasten gravel guard angles to base of scuppers.

a. Metallic-Coated Steel Sheet: Nominal 0.028-inch thickness.
b. Formed Aluminum Sheet: 0.032 inch thick.
c. Size: As indicated on Drawings.

5. Conductor Heads: Manufactured conductor heads, each with flanged back and stiffened top edge, and of dimensions and shape indicated, complete with outlet tube that nests into upper end of downspout .

a. Metallic-Coated Steel Sheet: Nominal 0.028-inch thickness.
b. Formed Aluminum Sheet: 0.032 inch thick.
c. Size: As indicated on Drawings.

6. Splash Pans: Fabricate from the following exposed metal:

a. Metallic-Coated Steel Sheet: Nominal 0.028-inch thickness.
b. Formed Aluminum Sheet: 0.040 inch thick.
c. Formed Stainless Steel Sheet: 0.0188 inch thick.
d. Size: As indicated on Drawings.

7. Finishes:

a. Metallic-Coated Steel: Three-coat fluoropolymer.

1) Color: As selected by Architect from manufacturer's full range.

b. Aluminum: Three-coat fluoropolymer.

1) Color: As selected by Architect from manufacturer's full range.

c. Stainless Steel: ASTM A480/A480M No. 2B (bright, cold rolled, unpolished).

2.5 REGLETS AND COUNTERFLASHINGS

A. Surface-Mounted Reglets:

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. ATAS International, Inc.
b. Berridge Manufacturing Company
c. Castle Metal Products
d. Cheney Flashing Company

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e. Drexel Metals Corp. – Carlisle Construction Materials
f. EXCEPTIONAL Metals
g. Fry Reglet Corporation
h. Heckmann Building Products, Inc.
i. Keystone Flashing Company, Inc
j. Metal-Era, Inc.; a Carlisle Company
k. OMG Roofing Products; a Division of OMG, Inc.

2. Description: Manufactured units formed to provide secure interlocking of separate surface-mounted reglet and counterflashing pieces, from the following exposed metal:

   a. Metallic-Coated Steel Sheet: Nominal 0.028-inch thickness.
   b. Formed Aluminum Sheet: 0.050 inch thick.

3. Corners: Factory mitered and mechanically clinched and sealed watertight.
4. Surface-Mounted Type: Provide reglets with slotted holes for fastening to substrate, with neoprene or other suitable weatherproofing washers, and with channel for sealant at top edge.
5. Accessories:

   a. Flexible-Flashing Retainer: Provide resilient plastic or rubber accessory to secure flexible flashing in reglet where clearance does not permit use of standard metal counterflashing or where reglet is provided separate from metal counterflashing.

B. Counterflashings:

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. ATAS International, Inc.
   b. Berridge Manufacturing Company
   c. Castle Metal Products
   d. Cheney Flashing Company
   e. Drexel Metals Corp. – Carlisle Construction Materials
   f. EXCEPTIONAL Metals
   g. Fry Reglet Corporation
   h. Heckmann Building Products, Inc.
   i. Hickman; a Carlisle Company
   j. Keystone Flashing Company, Inc
   k. Metal-Era, Inc.; a Carlisle Company
   l. OMG Roofing Products; a Division of OMG, Inc.

2. Description: Manufactured units of heights to overlap top edges of base flashings by **4 inches** and in lengths not exceeding 12 ft. designed to snap into reglets through-wall-flashing receiver and compress against base flashings with joints lapped, from the following exposed metal:

   a. Metallic-Coated Steel Sheet: Nominal 0.028-inch thickness.
   b. Formed Aluminum Sheet: 0.032 inch thick.

3. Accessories:

   a. Counterflashing Wind-Restraint Clips: Provide clips to be installed before counterflashing to prevent wind uplift of counterflashing lower edge.

C. Finishes:

1. Metallic-Coated Steel: Three-coat fluoropolymer.

   a. Color: As selected by Architect from manufacturer's full range.

2. Aluminum: Three-coat fluoropolymer.

   a. Color: As selected by Architect from manufacturer's full range.

3. Stainless Steel: ASTM A480/A480M No. 2B (bright, cold rolled, unpolished).

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2.6 SHEET METAL MATERIALS

A. Metallic-Coated Steel Sheet: Zinc-coated (galvanized) steel sheet complying with minimum ASTM A653/A653M, **G90** coating designation, or aluminum-zinc alloy-coated steel sheet complying with minimum ASTM A792/A792M, **Class AZ50** coating designation; structural quality.

1. Mill-Phosphatized Finish: Manufacturer's standard for field painting.
2. Factory Prime Coating: Where field painting is indicated, apply pretreatment and white or light-colored, factory-applied, baked-on epoxy primer coat, with a minimum dry film thickness of **0.2 mil**.
3. Exposed Coil-Coated Finish: Prepainted by the coil-coating process to comply with ASTM A755/A755M. Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions.

    a. Two-Coat Fluoropolymer Finish: AAMA 2605. System consisting of primer and fluoropolymer color topcoat containing not less than 70 percent PVDF resin by weight in color coat.

4. Concealed Finish: Pretreat with manufacturer's standard white or light-colored acrylic or polyester-backer finish consisting of prime coat and wash coat, with a minimum total dry film thickness of **0.5 mil**.

B. Aluminum Sheet: ASTM B209/B209M, manufacturer's standard alloy for finish required, with temper to suit forming operations and performance required.

1. Mill Finish: As manufactured.
2. Factory Prime Coating: Where field painting is indicated, apply pretreatment and white or light-colored, factory-applied, baked-on epoxy primer coat, with a minimum dry film thickness of **0.2 mil**.
3. Clear Anodic Finish: AAMA 611, AA-M12C22A41, Class I, 0.018 mm or thicker.
4. Exposed Coil-Coated Finish: Prepainted by the coil-coating process to comply with ASTM A755/A755M. Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions.

    a. Two-Coat Fluoropolymer Finish: AAMA 2605. System consisting of primer and fluoropolymer color topcoat containing not less than 70 percent PVDF resin by weight in color coat.

5. Concealed Finish: Pretreat with manufacturer's standard white or light-colored acrylic or polyester-backer finish consisting of prime coat and wash coat, with a minimum total dry film thickness of **0.5 mil**.

C. Aluminum Extrusions and Tubes: **ASTM B221**, manufacturer's standard alloy and temper for type of use, finished to match assembly where used; otherwise, mill finished.

D. Stainless Steel Sheet: ASTM A240/A240M or ASTM A666, Type 304.

2.7 UNDERLAYMENT

A. Self-Adhering, High-Temperature Sheet Underlayment: Provide self-adhering, cold-applied, sheet underlayment, specifically designed to withstand high metal temperatures beneath metal roofing. Provide primer when recommended by underlayment manufacturer.

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. ATAS International, Inc.
    b. Carlisle Companies
    c. Carlisle WIP Products; a brand of Carlisle Construction Materials
    d. GCP Applied Technologies Inc.
    e. Henry, a Carlisle Company (formerly Henry Company and Carlisle Coatings & Waterproofing Inc. brands)
    f. Palisade; Brand of Intertape Polymer Group (IPG)
    g. Polyglass U.S.A., Inc.

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h. Protecto Wrap Company

2. Minimum Thickness: **30 mils**.
3. Thermal Stability: Stable after testing at **240 deg F**; ASTM D1970/D1970M.
4. Low-Temperature Flexibility: Passes after testing at **minus 20 deg F** or lower; ASTM D1970/D1970M.

B. Felt Underlayment : ASTM D226/D226M, Type II (No. 30), asphalt-saturated organic felt, nonperforated.

C. Slip Sheet : Rosin-sized building paper, **3-lb/100 sq. ft.** minimum.

2.8 MISCELLANEOUS MATERIALS

A. Provide materials and types of fasteners, protective coatings, sealants, and other miscellaneous items required by manufacturer for a complete installation.

B. Fasteners: Roof specialty manufacturer's recommended fasteners, designed to meet performance requirements, suitable for application and metals being fastened. Match finish of exposed fasteners with finish of material being fastened. Provide nonremovable fastener heads to exterior exposed fasteners. Furnish the following unless otherwise indicated:

1. Fasteners for Metallic-Coated Steel Sheet: Series 300 stainless steel or hot-dip zinc-coated steel in accordance with ASTM A153/A153M or ASTM F2329/F2329M.
2. Fasteners for Aluminum Sheet: Aluminum or Series 300 stainless steel.
3. Fasteners for Stainless Steel Sheet: Series 300 stainless steel.
4. Fasteners for Copper Sheet: Copper, hardware bronze, or passivated Series 300 stainless steel.
5. Exposed Penetrating Fasteners: Gasketed screws with hex washer heads matching color of sheet metal.

C. Gaskets: Manufacturer's standard tubular or fingered design of neoprene, EPDM, PVC, or silicone or a flat design of foam rubber, sponge neoprene, or cork.

D. Elastomeric Sealant: ASTM C920, elastomeric silicone polymer sealant of type, grade, class, and use classifications required by roofing-specialty manufacturer for each application.

E. Butyl Sealant: ASTM C1311, single-component, solvent-release butyl rubber sealant; polyisobutylene plasticized; heavy bodied for hooked-type joints with limited movement.

F. Bituminous Coating: Cold-applied asphalt emulsion complying with ASTM D1187/D1187M.

2.9 GENERAL FINISH REQUIREMENTS

A. Comply with NAAMM/NOMMA AMP 500, "Metal Finishes Manual for Architectural and Metal Products," for recommendations for applying and designating finishes.

B. Protect mechanical and painted finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.

C. 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 substrates, areas, and conditions, with Installer present, to verify actual locations, dimensions, and other conditions affecting performance of the Work.

B. Examine walls, roof edges, and parapets for suitable conditions for roof specialties.

C. Verify that substrate is sound, dry, smooth, clean, sloped for drainage where applicable, and securely

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anchored.

D. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION OF UNDERLAYMENT

A. Self-Adhering, High-Temperature Sheet Underlayment:

1. Install self-adhering, high-temperature sheet underlayment; wrinkle free.
2. Prime substrate if recommended by underlayment manufacturer.
3. Comply with temperature restrictions of underlayment manufacturer for installation; use primer for installing underlayment at low temperatures.
4. Apply in shingle fashion to shed water, with end laps of not less than **6 inches** staggered **24 inches** between courses.
5. Overlap side edges not less than **3-1/2 inches**. Roll laps and edges with roller.
6. Roll laps and edges with roller.
7. Cover underlayment within 14 days.

B. Felt Underlayment: Install felt underlayment, wrinkle free, using adhesive to minimize use of mechanical fasteners under sheet metal flashing and trim.

1. Install in shingle fashion to shed water.
2. Lap joints not less than **2 inches**.

C. Slip Sheet: Install slip sheet, wrinkle free, over underlayment before installing sheet metal flashing and trim.

1. Install in shingle fashion to shed water.
2. Lapp joints not less than **4 inches**.

3.3 INSTALLATION OF ROOF SPECIALTIES, GENERAL

A. Install roof specialties in accordance with manufacturer's written instructions. Anchor roof specialties securely in place, with provisions for thermal and structural movement. Use fasteners, solder, protective coatings, separators, underlayments, sealants, and other miscellaneous items as required to complete roof-specialty systems.

1. Install roof specialties level, plumb, true to line and elevation; with limited oil-canning and without warping, jogs in alignment, buckling, or tool marks.
2. Provide uniform, neat seams with minimum exposure of solder and sealant.
3. Install roof specialties to fit substrates and to result in weathertight performance. Verify shapes and dimensions of surfaces to be covered before manufacture.
4. Torch cutting of roof specialties is not permitted.
5. Do not use graphite pencils to mark metal surfaces.

B. Metal Protection: Protect metals against galvanic action by separating dissimilar metals from contact with each other or with corrosive substrates by painting contact surfaces with bituminous coating or by other permanent separation as recommended by manufacturer's written installation instructions.

1. Coat concealed side of uncoated aluminum and stainless steel roof specialties with bituminous coating where in contact with wood, ferrous metal, or cementitious construction.
2. Bed flanges in thick coat of asphalt roofing cement where required by manufacturers of roof specialties for waterproof performance.

C. Expansion Provisions: Allow for thermal expansion of exposed roof specialties.

1. Space movement joints at a maximum of 12 ft. with no joints within 18 inches of corners or intersections unless otherwise indicated on Drawings.
2. When ambient temperature at time of installation is between **40 and 70 deg F**, set joint members for 50 percent movement each way. Adjust setting proportionately for installation at higher ambient temperatures.

D. Fastener Sizes: Use fasteners of sizes that penetrate substrate not less than recommended in writing by fastener manufacturer to achieve maximum pull-out resistance.

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E. Seal concealed joints with butyl sealant as required by roof specialty manufacturer.

F. Seal joints as required for weathertight construction. Place sealant to be completely concealed in joint. Do not install sealants at temperatures below **40 deg F**.

G. Soldered Joints: Clean surfaces to be soldered, removing oils and foreign matter. Pre-tin edges of sheets to be soldered to a width of **1-1/2 inches**; however, reduce pre-tinning where pre-tinned surface would show in completed Work. Tin edges of uncoated copper sheets using solder for copper. Do not use torches for soldering. Heat surfaces to receive solder and flow solder into joint. Fill joint completely. Completely remove flux and spatter from exposed surfaces.

3.4 INSTALLATION OF COPINGS

A. Install cleats, anchor plates, and other anchoring and attachment accessories and devices with concealed fasteners.

B. Anchor copings with manufacturer's required devices, fasteners, and fastener spacing to meet performance requirements.

1. Interlock face and back leg drip edges of snap-on coping cap into cleated anchor plates anchored to substrate at manufacturer's required spacing that meets performance requirements.
2. Interlock face-leg drip edge into continuous cleat anchored to substrate at manufacturer's required spacing that meets performance requirements. Anchor back leg of coping with screw fasteners and elastomeric washers at manufacturer's required spacing that meets performance requirements.

3.5 INSTALLATION OF ROOF-EDGE SPECIALTIES

A. Install cleats, cants, and other anchoring and attachment accessories and devices with concealed fasteners.

B. Anchor roof edgings with manufacturer's required devices, fasteners, and fastener spacing to meet performance requirements.

3.6 INSTALLATION OF ROOF-EDGE DRAINAGE SYSTEMS

A. Install components to produce a complete roof-edge drainage system in accordance with manufacturer's written instructions. Coordinate installation of roof perimeter flashing with installation of roof-edge drainage system.

B. Gutters: Join and seal gutter lengths. Allow for thermal expansion. Attach gutters to firmly anchored gutter supports spaced not more than 24 inches apart. Attach ends with rivets and seal with sealant to make watertight. Slope to downspouts.

1. Install gutter with expansion joints at locations indicated but not exceeding 50 ft. apart. Install expansion-joint caps.

C. Downspouts: Join sections with manufacturer's standard telescoping joints. Provide hangers with fasteners designed to hold downspouts securely to walls and **1 inch** away from walls; locate fasteners at top and bottom and at approximately 60 inches o.c.

1. Provide elbows at base of downspouts at grade to direct water away from building.
2. Connect downspouts to underground drainage system indicated.

D. Splash Pans: Install where downspouts discharge on low-slope roofs. Set in elastomeric sealant.

E. Parapet Scuppers: Install scuppers through parapet where indicated. Continuously support scupper, set to correct elevation, and seal flanges to interior wall face, over cants or tapered edge strips, and under roofing membrane.

1. Anchor scupper closure trim flange to exterior wall and seal or solder to scupper.
2. Loosely lock front edge of scupper with conductor head.
3. Seal or solder exterior wall scupper flanges into back of conductor head.

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F. Conductor Heads: Anchor securely to wall with elevation of conductor top edge **1 inch** below scupper discharge.

3.7 INSTALLATION OF REGLETS AND COUNTERFLASHINGS

A. Coordinate installation of reglets and counterflashings with installation of base flashings.

B. Surface-Mounted Reglets: Install reglets to receive flashings where flashing without embedded reglets is indicated on Drawings. Install at height so that inserted counterflashings overlap **4 inches** over top edge of base flashings.

C. Counterflashings: Insert counterflashings into reglets or other indicated receivers; ensure that counterflashings overlap **4 inches** over top edge of base flashings. Lap counterflashing joints a minimum of **4 inches** and bed with butyl sealant. Fit counterflashings tightly to base flashings.

3.8 CLEANING

A. Galvanized Surfaces: Clean field welds, bolted connections, and abraded areas and repair galvanizing in accordance with ASTM A780/A780M.

B. Touch up factory-primed surfaces with compatible primer ready for field painting in accordance with Section 099113 "Exterior Painting."

C. Clean and neutralize flux materials. Clean off excess solder and sealants.

D. Remove temporary protective coverings and strippable films as roof specialties are installed. On completion of installation, clean finished surfaces, including removing unused fasteners, metal filings, pop rivet stems, and pieces of flashing. Maintain roof specialties in a clean condition during construction.

3.9 PROTECTION

A. Replace roof specialties that have been damaged or that cannot be successfully repaired by finish touchup or similar minor repair procedures, as determined by Architect.

END OF SECTION 07 71 00

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SECTION 07 72 53 - SNOW GUARDS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Pad-type, flat-mounted metal snow guards.
2. Pad-type, seam-mounted cast-metal snow guards.

1.2 ACTION SUBMITTALS

A. Product Data: Include construction details, material descriptions, dimensions of individual components and profiles, and finishes.

1. Pad-type, flat-mounted metal snow guards.
2. Pad-type, seam-mounted cast-metal snow guards.

B. Shop Drawings: Include roof plans showing layouts and attachment details of snow guards.

1. Include details of rail-type snow guards.

C. Samples:

1. Pad-Type Snow Guards: Full-size unit with installation hardware.

a. For units with factory-applied finishes, submit manufacturer's standard color selections.

2. Rail-Type Snow Guards: Bracket, **12-inch-** long rail, and installation hardware.

a. For units with factory-applied finishes, submit manufacturer's standard color selections.

D. Delegated Design Submittals: For snow guards, include analysis reports signed and sealed by the qualified professional engineer responsible for their preparation.

1. Include calculation of number and location of snow guards.

1.3 INFORMATIONAL SUBMITTALS

A. Qualification Data: For professional engineer's experience with providing delegated design engineering services of the kind indicated, including documentation that the engineer is licensed in the state in which the Project is located.

B. Product Test Reports: For each type of snow guard, for tests performed by a qualified testing agency, indicating load at failure of attachment to roof system identical to roof system used on this Project.

1.4 FIELD CONDITIONS

A. Weather Limitations: Proceed with installation only when existing and forecasted weather conditions permit adhesive-mounted snow guards to be installed, and adhesive cured, according to adhesive manufacturer's written instructions.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Delegated Design: Engage a qualified professional engineer, as defined in Section 014000 "Quality Requirements," to design snow guards, including attachment to roofing material and roof deck, as applicable for attachment method, based on the following:

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1. Roof snow load.
2. Snow drifting
3. Roof slope.
4. Roof type.
5. Roof dimensions.
6. Roofing substrate type and thickness.
7. Snow guard type.
8. Snow guard fastening method and strength.
9. Snow guard spacing.
10. Coefficient of Friction Between Snow and Roof Surface: 0.
11. Factor of Safety: 2.

B. Performance Requirements: Provide snow guards that withstand exposure to weather and resist thermally induced movement without failure, rattling, or fastener disengagement due to defective manufacture, fabrication, installation, or other defects in construction.

1. Temperature Change: 120 deg F, ambient; 180 deg F, material surfaces.

C. Structural Performance: Snow guards to withstand the effects of gravity loads and the following loads and stresses within limits and under conditions indicated.

1. Snow Loads: As indicated on Drawings.

2.2 PAD-TYPE SNOW GUARDS

A. Pad-Type, Flat-Mounted Metal Snow Guards:

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. Alpine SnowGuards, a division of Vermont Slate & Copper Services, Inc
b. Berger; division of OmniMax International, Inc.
c. IceBlox Inc.
d. Rocky Mountain Snow Guards, Inc.
e. Sieger Snow Guards Inc.
f. TRA Snow and Sun, Inc.
g. Zaleski Snow-Guards for Roofs, Inc.

2. Material:

a. Aluminum Sheet: **ASTM B209**, not less than 0.040 inch thick.

1) Finish: High-performance organic two-coat fluoropolymer finish complying with AAMA 2605 and containing not less than 70 percent PVDF resin by weight in color coat.

a) Color: As selected by Architect from manufacturer's full range.

b. Metallic-Coated Steel Sheet: ASTM A653/A653M, with **G90** coating, not less than 0.022 inch thick.

1) Finish: High-performance organic two-coat fluoropolymer finish complying with AAMA 2605 and containing not less than 70 percent PVDF resin by weight in color coat.

a) Color: As selected by Architect from manufacturer's full range.

3. Attachment: Manufacturer's tested system, capable of resisting design loads.

B. Pad-Type, Seam-Mounted Cast-Metal Snow Guards:

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. Alpine SnowGuards, a division of Vermont Slate & Copper Services, Inc

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b. Berger; division of OmniMax International, Inc.
c. Levi's Building Components
d. Sieger Snow Guards Inc.
e. TRA Snow and Sun, Inc.

2. Material:

a. Cast Aluminum: ASTM B26/B26M; factory black epoxy finish.
b. Cast Bronze: ASTM B584; polished finish.
c. Cast Brass: ASTM B584; polished finish.

3. Attachment: Manufacturer's tested system, capable of resisting design loads.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates and conditions, with Installer present, for compliance with requirements for installation tolerances, snow guard attachment, and other conditions affecting performance of the Work.

1. Verify compatibility with and suitability of substrates, including compatibility with existing finishes or primers.

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

3.2 PREPARATION

A. Clean and prepare substrates for bonding snow guards.

B. Prime substrates according to snow guard manufacturer's written instructions.

3.3 INSTALLATION

A. Install snow guards according to manufacturer's written instructions.

1. Space rows as indicated on Shop Drawings.
2. Space rows as recommended by manufacturer.

B. Attachment for Asphalt Shingle Roofing:

1. Pad-Type, Flat-Mounted Snow Guards: Mechanically anchored through each factory-prepared hole with fasteners concealed by the shingles.

C. Attachment for Standing-Seam Metal Roofing:

1. Do not use fasteners that will penetrate metal roofing or fastening methods that void metal roofing finish warranty.
2. Pad-Type, Flat-Mounted Snow Guards:

a. Mechanically attach to metal roofing in accordance with manufacturer's written instructions.
b. Solder to copper roofing in accordance with manufacturer's written instructions.

3. Pad-Type, Seam-Mounted Snow Guards:

a. Install snow guards in straight rows.
b. Secure in place using stainless steel set screws, incorporating round nonpenetrating point.
c. Torque set screw in accordance with manufacturer's written instructions.

D. Attachment for Exposed Fastened Metal Roofing:

1. Do not use fasteners that will void metal roofing finish warranty.

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2. Pad-Type, Flat-Mounted Snow Guards:

    a. Adhere to metal roofing in accordance with manufacturer's written instructions.
    b. Mechanically fasten to metal roofing, using fasteners identical to those used to secure metal roofing to substrate.
    c. Solder to copper roofing in accordance with manufacturer's written instructions.

END OF SECTION 07 72 53

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SECTION 07 84 13 - PENETRATION FIRESTOPPING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes: Penetration firestopping systems.

1. Penetration firestopping systems in fire-resistance-rated walls.
2. Penetration firestopping systems in horizontal assemblies.
3. Penetration firestopping systems in smoke barriers.
4. Exposed penetration firestopping systems.

B. Related Requirements:

1. Section 078443 "Joint Firestopping" for joints in or between fire-resistance-rated construction, at exterior curtain-wall/floor intersections, and in smoke barriers.
2. Section 079200 "Joint Sealants" for non-fire-resistance-rated joint sealants.
3. Section 079219 "Acoustical Joint Sealants" for sealing joints in sound-rated construction.

1.2 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Product Schedule: For each penetration firestopping system. Include location, illustration of firestopping system, and design designation of qualified testing and inspecting agency.

C. Unlisted Firestopping Systems: Obtain an Engineering Judgment (EJ) from firestopping manufacturer where no UL, FM Approvals, or other listed assembly is available for particular firestop configuration. Follow International Firestop Council (IFC) recommended guidelines for evaluating firestopping systems in EJs.

1. Engineering Judgments: Where Project conditions require modification to a qualified testing and inspecting agency's illustration for a particular penetration firestopping system, submit illustration, with modifications marked, approved by penetration firestopping system manufacturer's fire-protection engineer as an engineering judgment or equivalent fire-resistance-rated assembly developed in accordance with current International Firestop Council (IFC) recommended guidelines. Obtain approval of authorities having jurisdiction prior to submittal.

1.4 INFORMATIONAL SUBMITTALS

A. Qualification Data: For Installer.

B. Listed System Designs: For each penetration firestopping system, for tests performed by a qualified testing agency.

1.5 CLOSEOUT SUBMITTALS

A. Installer Certificates: From Installer indicating that penetration firestopping systems have been installed in compliance with requirements and manufacturer's written instructions.

1.6 QUALITY ASSURANCE

A. Installer Qualifications: Entity that has been approved by FM Approvals in accordance with FM

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Approvals 4991 or been evaluated by UL Solutions and found to comply with "UL Solutions Qualified Firestop Contractor Program."

B. Manufacturer Qualifications: Entity that has received UL Solutions' "Firestop Movement Certification," which demonstrates that manufacturer's firestopping products designated with M-Ratings are based on exposure to cyclic movement and UL 1479 fire test evaluation when tested in accordance with ASTM E3037.

1.7 FIELD CONDITIONS

A. Environmental Limitations: Do not install penetration firestopping systems when ambient or substrate temperatures are outside limits permitted by penetration firestopping system manufacturers or when substrates are wet because of rain, frost, condensation, or other causes.

B. Install and cure penetration firestopping system materials in accordance with manufacturer's written instructions using natural means of ventilations or, where this is inadequate, forced-air circulation.

1.8 COORDINATION

A. Coordinate construction of openings and penetrating items to ensure that penetration firestopping systems can be accessed and installed in accordance with specified firestopping system design.

B. Coordinate sizing of sleeves, openings, core-drilled holes, or cut openings to accommodate penetration firestopping systems.

PART 2 - PRODUCTS

2.1 SOURCE LIMITATIONS

A. Obtain penetration firestopping systems for each type of opening indicated from single manufacturer.

2.2 PENETRATION FIRESTOPPING SYSTEMS

A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1. 3M Building and Construction
2. Balco; a CSW Industrials Company
3. Everkem Diversified Products, Inc.
4. FireShield; Fire Rated Solutions LLC
5. Grabber Construction Products, Inc.
6. Hilti, Inc.
7. Holdrite; a division of Reliance Worldwide Corporation
8. International Fireproof Technology Inc
9. NUCO Inc
10. Passive Fire Protection Partners
11. Roxtec Inc.
12. Specified Technologies Inc.
13. STC Sound Control
14. Tremco Incorporated
15. Unique Fire Stop Products

B. Penetration firestopping systems must be compatible with one another, with the substrates forming openings, and with penetrating items if any.

1. Penetration firestopping systems must be installed with products bearing the classification marking of a qualified testing agency.

   a. UL Solutions in its online directory "Product iQ."
   b. Intertek Group in its "Directory of Building Products."
   c. FM Approvals in its "Approval Guide."

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2. Provide components for each penetration firestopping system that, upon curing, do not re-emulsify, dissolve, leach, break down, or otherwise deteriorate over time from exposure to atmospheric moisture, sweating pipes, ponding water, or other forms of moisture characteristic during and after construction.
3. Provide components for each penetration firestopping system that do not contain ethylene glycol.
4. Provide components for each penetration firestopping system that are sufficiently flexible to accommodate movement, such as pipe vibration, water hammer, thermal expansion, and other normal building movement without damage.
5. Provide components for each penetration firestopping system that are appropriately tested for the thickness and type of insulation utilized.

C. Provide penetration firestopping systems that resist spread of fire, resist passage of smoke and other gases, and maintain original fire-resistance rating of construction penetrated.

D. Penetration Firestopping Systems in Fire-Resistance-Rated Walls: Systems with ratings determined in accordance with ASTM E814 or UL 1479.

1. F-Rating: Not less than the fire-resistance rating of the wall assembly penetrated.
2. Membrane Penetrations: Install recessed fixtures such that the required fire resistance will not be reduced.

E. Penetration Firestopping Systems in Horizontal Assemblies: Systems with ratings determined in accordance with ASTM E814 or UL 1479.

1. F-Rating: At least one hour, but not less than the fire-resistance rating of the floor/ceiling assembly penetrated.

F. Penetration Firestopping Systems in Smoke Barriers: Systems with ratings determined in accordance with UL 1479.

1. L-Rating: Not exceeding **5.0 cfm/sq. ft.** of penetration opening and no more than **50-cfm** cumulative total for any **100 sq. ft.** at both ambient and elevated temperatures.
2. M-Rating: Provide penetration firestopping systems meeting specified L-Rating after being tested in accordance with ASTM E3037.

G. Exposed Penetration Firestopping Systems: Flame-spread and smoke-developed indexes of less than 25 and 450, respectively, when tested in accordance with ASTM E84 or UL 723.

2.3 ACCESSORIES

A. Provide components for each penetration firestopping system that are needed to install fill materials and to maintain ratings required. Use only those components specified by penetration firestopping system manufacturer and approved by qualified testing and inspecting agency for conditions indicated, including but not limited to:

1. Permanent forming/damming/backing materials.
2. Substrate primers.
3. Collars.
4. Steel sleeves.

2.4 FILL MATERIALS

A. Cast-in-Place Firestopping Devices: Factory-assembled devices for use in cast-in-place concrete floors and consisting of an outer sleeve lined with an intumescent strip, a flange attached to one end of the sleeve for fastening to concrete formwork, and a neoprene gasket.

B. Latex Sealants: Single-component latex formulations that do not re-emulsify after cure during exposure to moisture.

C. Firestopping Devices: Factory-assembled collars formed from galvanized steel and lined with intumescent material sized to fit specific diameter of penetrant.

D. Intumescent Composite Sheets: Rigid panels consisting of aluminum-foil-faced intumescent

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elastomeric sheet bonded to galvanized-steel sheet.

E. Intumescent Putties: Nonhardening, water-resistant, intumescent putties containing no solvents or inorganic fibers.

F. Intumescent Wrap Strips: Single-component intumescent elastomeric strips for use around combustible penetrants.

G. Mortars: Prepackaged dry mixes consisting of a blend of inorganic binders, hydraulic cement, fillers and lightweight aggregate formulated for mixing with water at Project site to form a nonshrinking, homogeneous mortar.

H. Pillows/Bags: Compressible, removable, and reusable intumescent pillows encased in fire-retardant polyester or glass-fiber cloth. Where exposed, and when required by a listed system, cover openings with steel-reinforcing wire mesh to protect pillows/bags from being easily removed or dislodged.

I. Silicone Foams: Multicomponent, silicone-based liquid elastomers that, when mixed, expand and cure in place to produce a flexible, nonshrinking foam.

J. Silicone Sealants: Single-component, silicone-based, neutral-curing elastomeric sealants.

K. Thermal and Endothermic Wraps: Flexible, insulating, and fire-resistant protective wraps tested and listed for up to 2-hour fire ratings in accordance with ASTM E814 or UL 1479; for protecting membrane penetrations of utility boxes, critical electrical circuits, communications lines, and fuel lines, and for thermal barrier and circuit integrity protection in accordance with ASTM E1725 or UL 1724.

L. Fire-Rated Cable Sleeve Kits: Complete kits designed for new or existing cable penetrations through walls which accept standard accessories.

M. Fire-Rated Cable Pathways: Single or gangable device modules composed of a steel raceway with integral intumescent material and requiring no additional action in the form of plugs, twisting closure, putty, pillows, sealant, or otherwise to achieve fire and air-leakage ratings.

1. Fire-rated cable pathway devices are the preferred product for data, video, and communications cable penetrations. Install these devices in locations where frequent cable moves, add-ons, and changes will occur. Such devices must be:

   a. Capable of retrofit around existing cables.
   b. Designed so that two or more devices can be ganged together.
   c. Maintenance-free so no action is required to activate the smoke- and fire-sealing mechanism.

2. Where fire-rated cable pathway devices are not practical, openings within walls and floors designed to accommodate data, video, and communications cabling must be provided with re-enterable products specifically designed for retrofit, such as retrofit devices for cable bundles, firestopping putty, plugs, or pillows.

N. Retrofit Device for Cable Bundles: Factory-made, intumescent, collar-like device for firestopping existing over-filled cable sleeves and capable of being installed around projecting sleeves and cable bundles.

O. Wall-Opening Protective Materials: Intumescent, non-curing putty pads or self-adhesive inserts for protection of electrical switch and receptacle boxes.

P. Fire-Rated HVAC Retaining Angles: Steel angle system with integral intumescent firestopping gasket for use around rectangular steel HVAC ducts without fire dampers.

Q. Firestopping Plugs: Flexible, re-enterable, intumescent, foam-rubber plug for use in blank round openings and cable sleeves.

R. Fire-Rated Cable Grommet: Molded two-piece grommet made of plenum-grade polymer and foam inner core for sealing small cable penetrations in gypsum walls up to **1/2 inch** in diameter.

S. Closet Flange Gasket: Molded, single-component, flexible, intumescent gasket for use beneath a water closet (toilet) flange in floor applications.

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2.5 MIXING

A. Penetration Firestopping Materials: For those products requiring mixing before application, comply with penetration firestopping system manufacturer's written instructions for accurate proportioning of materials, water (if required), type of mixing equipment, selection of mixer speeds, mixing containers, mixing time, and other items or procedures needed to produce products of uniform quality with optimum performance characteristics for application indicated.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates and conditions, with Installer present, for compliance with requirements for opening configurations, penetrating items, substrates, and other conditions affecting performance of the Work.

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

3.2 PREPARATION

A. Surface Cleaning: Before installing penetration firestopping systems, clean out openings in accordance with manufacturer's written instructions and with the following requirements:

1. Remove foreign materials from substrate surfaces that could interfere with adhesion of penetration firestopping materials.
2. Clean opening substrates and penetrating items to produce clean, sound surfaces capable of developing optimum bond with penetration firestopping materials. Remove loose particles remaining from cleaning operation.
3. Remove laitance and form-release agents from concrete.

B. Prime substrates in accordance with penetration firestopping system manufacturer's written installation instructions, using that manufacturer's recommended products and methods. Confine primers to areas of bond; do not allow spillage and migration onto exposed surfaces.

3.3 INSTALLATION OF PENETRATION FIRESTOPPING SYSTEMS

A. General: Install penetration firestopping systems in accordance with manufacturer's written installation instructions and published drawings for products and applications.

B. Install forming materials and other accessories of types required to support fill materials during their application and in the position needed to produce cross-sectional shapes and depths required to achieve fire ratings indicated.

1. After installing fill materials and allowing them to fully cure, remove combustible forming materials and other accessories not forming permanent components of firestopping.

C. Install fill materials by proven techniques to produce the following results:

1. Fill voids and cavities formed by openings, forming materials, accessories, and penetrating items to achieve required fire-resistance ratings.
2. Apply materials so they contact and adhere to substrates formed by openings and penetrating items.
3. For fill materials that will remain exposed after completing the Work, finish to produce smooth, uniform surfaces that are flush with adjoining finishes.

3.4 IDENTIFICATION

A. Wall Identification: Permanently label walls containing penetration firestopping systems with the words "FIRE AND/OR SMOKE BARRIER - PROTECT ALL OPENINGS," using lettering not less than **3 inches** high and with minimum **0.375-inch** strokes.

1. Locate in accessible concealed floor, floor-ceiling, or attic space at **15 ft.** from end of wall and at

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intervals not exceeding **30 ft.**.

B. Penetration Identification: Identify each penetration firestopping system with legible metal or plastic labels. Attach labels permanently to surfaces adjacent to and within **6 inches** of penetration firestopping system edge so labels are visible to anyone seeking to remove penetrating items or firestopping systems. Use mechanical fasteners or self-adhering-type labels with adhesives capable of permanently bonding labels to surfaces on which labels are placed. Include the following information on labels:

1. The words "Warning - Penetration Firestopping - Do Not Disturb. Notify Building Management of Any Damage."
2. Contractor's name, address, and phone number.
3. Designation of applicable testing and inspecting agency.
4. Date of installation.
5. Manufacturer's name.
6. Installer's name.

3.5 FIELD QUALITY CONTROL

A. Owner will engage a qualified inspection agency to conduct and report on inspections in accordance with ASTM E2174.

B. Where deficiencies are found or penetration firestopping system is damaged or removed because of testing, repair or replace penetration firestopping system to comply with requirements.

C. Proceed with enclosing penetration firestopping systems with other construction only after inspection reports are issued and installations comply with requirements.

3.6 CLEANING AND PROTECTION

A. Clean off excess fill materials adjacent to openings as the Work progresses by methods and with cleaning materials that are approved in writing by penetration firestopping system manufacturers and that do not damage materials in which openings occur.

B. Provide final protection and maintain conditions during and after installation that ensure that penetration firestopping systems are without damage or deterioration at time of Substantial Completion. If, despite such protection, damage or deterioration occurs, immediately cut out and remove damaged or deteriorated penetration firestopping material and install new materials to produce systems complying with specified requirements.

END OF SECTION 07 84 13

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SECTION 07 84 43 - JOINT FIRESTOPPING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Joints in or between fire-resistance-rated construction.

B. Related Requirements:

1. Section 078413 "Penetration Firestopping" for penetrations in fire-resistance-rated walls, horizontal assemblies, and smoke barriers and for wall identification.
2. Section 079513.13 "Interior Expansion Joint Cover Assemblies" for fire-resistive manufactured expansion-joint cover assemblies for interior floors, walls, and ceilings.
3. Section 079513.16 "Exterior Expansion Joint Cover Assemblies" for fire-resistive manufactured expansion-joint cover assemblies for exterior building walls, soffits, and parapets.
4. Section 079513.19 "Parking Deck Expansion Joint Cover Assemblies" for fire-resistive manufactured expansion-joint cover assemblies subject to vehicular traffic.
5. Section 092216 "Non-Structural Metal Framing" for firestop tracks for metal-framed partition heads.

1.2 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1.3 ACTION SUBMITTALS

A. Product Data:

1. For each type of product.

B. Unlisted Firestopping Systems: Obtain an Engineering Judgment (EJ) from firestop manufacturer where no UL, FM Approvals, or other listed assembly is available for particular firestop configuration. Follow International Firestop Council (IFC) recommended guidelines for evaluating firestop systems in EJs.

C. Product Schedule: For each joint firestopping system. Include location, illustration of firestopping system, and design designation of qualified testing agency.

1. Engineering Judgments: Where Project conditions require modification to a qualified testing agency's illustration for a particular joint firestopping system condition, submit illustration, with modifications marked, approved by joint firestopping system manufacturer's fire-protection engineer as an EJ or equivalent fire-resistance-rated assembly developed in accordance with current IFC guidelines.

1.4 INFORMATIONAL SUBMITTALS

A. Qualification Data: For Installer.

B. Listed System Designs: For each joint firestopping system, for tests performed by a qualified testing agency.

1.5 CLOSEOUT SUBMITTALS

A. Installer Certificates: From Installer indicating that joint firestopping systems have been installed in compliance with requirements and manufacturer's written installation instructions.

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1.6 QUALITY ASSURANCE

A. Installer Qualifications: A firm that has been approved by FM Approvals in accordance with FM Approvals 4991 or been evaluated by UL and found to comply with UL's "UL Solutions Qualified Firestop Contractor Program."

1.7 FIELD CONDITIONS

A. Environmental Limitations: Do not install joint firestopping systems when ambient or substrate temperatures are outside limits permitted by joint firestopping system manufacturers or when substrates are wet due to rain, frost, condensation, or other causes.

B. Install and cure joint firestopping systems in accordance with manufacturer's written installation instructions using natural means of ventilation or, where this is inadequate, forced-air circulation.

1.8 COORDINATION

A. Coordinate construction of joints to ensure that joint firestopping systems can be installed in accordance with specified firestopping system design.

B. Coordinate sizing of joints to accommodate joint firestopping systems.

PART 2 - PRODUCTS

2.1 SOURCE LIMITATIONS

A. Obtain joint firestop systems for each type of joint opening indicated from single manufacturer.

2.2 PERFORMANCE REQUIREMENTS

A. Fire-Test-Response Characteristics:

1. A qualified testing agency, acceptable to authorities having jurisdiction, will perform joint firestopping system tests.
2. Test in accordance with testing standards referenced in "Joint Firestopping Systems" Article. Provide rated systems complying with the following requirements:

    a. Joint firestop systems installed with products bearing the classification marking of a qualified product certification agency in accordance with listed system designs published by a qualified testing agency.

        1) UL in its online directory "Product iQ."
        2) Intertek Group in its "Directory of Building Products."

B. Rain/Water Resistance: For perimeter fire-barrier system applications, where inclement weather or greater-than-transient water exposure is expected, use products that dry rapidly and cure in the presence of atmospheric moisture sufficient to pass ASTM D6904 early rain-resistance test (24-hour exposure).

2.3 JOINT FIRESTOPPING SYSTEM TYPES

A. General: Systems that resist spread of fire, passage of smoke and other gases, and maintain original fire-resistance rating of assemblies in or between which joint firestopping systems are installed. Joint firestopping systems must accommodate building movements without impairing their ability to resist the passage of fire and hot gases.

1. Joint firestopping systems that are compatible with one another, with the substrates forming openings, and with penetrating items, if any.
2. Provide products that, upon curing, do not re-emulsify, dissolve, leach, break down, or otherwise deteriorate over time from exposure to atmospheric moisture, sweating pipes, ponding water or other forms of moisture.

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3. Provide firestop products that do not contain ethylene glycol.

B. Joints in or between Fire-Resistance-Rated Construction: Provide joint firestopping systems with ratings determined in accordance with ASTM E1966 or UL 2079, with published L-Ratings for ambient and elevated temperatures as evidence of the ability of the fire-resistive joint system to restrict the movement of smoke.

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. 3M Building and Construction
b. Balco; a CSW Industrials Company
c. CEMCO; California Expanded Metal Products Co.
d. ClarkDietrich
e. CSW Industrials
f. Everkem Diversified Products, Inc.
g. Grabber Construction Products, Inc.
h. Hilti, Inc.
i. International Fireproof Technology Inc
j. Marino\WARE
k. Nelson; Emerson Electric Co., Automation Solutions
l. NUCO Inc
m. Owens Corning
n. Passive Fire Protection Partners
o. Rockwool International A/S
p. Specified Technologies Inc.
q. Tremco Incorporated
r. Willseal LLC, part of Tremco CPG

2. Fire-Resistance Rating: Equal to or exceeding the fire-resistance rating of the wall, floor, or roof in or between which it is installed.

C. Exposed Joint Firestopping Systems: Flame-spread and smoke-developed indexes of less than 25 and 450, respectively, as determined in accordance with ASTM E84.

2.4 ACCESSORIES

A. Provide components of joint firestopping systems, including primers and forming materials, that are needed to install elastomeric fill materials and to maintain ratings required. Use only components specified by joint firestopping system manufacturer and approved by the qualified testing agency for conditions indicated.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates and conditions, with Installer present, for compliance with requirements for joint configurations, substrates, and other conditions affecting performance of the Work.

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

3.2 PREPARATION

A. Surface Cleaning: Before installing joint firestopping systems, clean joints in accordance with fire-resistive joint system manufacturer's written installation instructions and the following requirements:

1. Remove foreign materials from substrate surfaces that could interfere with adhesion of elastomeric fill materials or compromise fire-resistive rating.
2. Clean joint substrates to produce clean, sound surfaces capable of developing optimum bond with elastomeric fill materials. Remove loose particles remaining from cleaning operation.
3. Remove laitance and form-release agents from concrete.

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B. Prime substrates in accordance with joint firestopping system manufacturer's written installation instructions, using that manufacturer's recommended products and methods. Confine primers to areas of bond; do not allow spillage and migration onto exposed surfaces.

C. Apply a suitable bond breaker to prevent three-sided adhesion in applications where condition occurs.

3.3 INSTALLATION

A. General: Install joint firestopping systems in accordance with manufacturer's written installation instructions and published drawings for products and applications indicated.

B. Install forming materials and other accessories of types required to support elastomeric fill materials during their application and in position needed to produce cross-sectional shapes and depths required to achieve fire ratings indicated.

1. After installing elastomeric fill materials and allowing them to fully cure, remove combustible forming materials and other accessories not indicated as permanent components of fire-resistive joint system.

C. Install elastomeric fill materials for joint firestopping systems by proven techniques to produce the following results:

1. Apply elastomeric fill in voids and cavities formed by joints and forming materials as required to achieve fire-resistance ratings indicated.
2. Apply elastomeric fill materials so they contact and adhere to substrates formed by joints.
3. For elastomeric fill materials that will remain exposed after completing the Work, finish to produce smooth, uniform surfaces that are flush with adjoining finishes.

3.4 IDENTIFICATION

A. Wall Identification: Permanently label walls containing firestopping systems with the words "FIRE AND/OR SMOKE BARRIER - PROTECT ALL OPENINGS," using lettering not less than **3 inches** high and with minimum **0.375-inch** strokes.

1. Locate in accessible concealed floor, floor-ceiling, or attic space at **15 ft.** from end of wall and at intervals not exceeding **30 ft.**.

B. Joint Identification: Identify joint firestopping systems with legible metal or plastic labels. Attach labels permanently to surfaces adjacent to and within **6 inches** of joint edge, so labels are visible to anyone seeking to remove joint firestopping system. Use mechanical fasteners or self-adhering-type labels with adhesives capable of permanently bonding labels to surfaces on which labels are placed. Include the following information on labels:

1. The words "Warning - Joint Firestopping - Do Not Disturb. Notify Building Management of Any Damage."
2. Contractor's name, address, and phone number.
3. Designation of applicable testing agency.
4. Date of installation.
5. Manufacturer's name.
6. Installer's name.

3.5 FIELD QUALITY CONTROL

A. Owner will engage a qualified testing agency to perform tests and inspections in accordance with ASTM E2393.

B. Where deficiencies are found or joint firestopping systems are damaged or removed due to testing, repair or replace joint firestopping systems so they comply with requirements.

C. Proceed with enclosing joint firestopping systems with other construction only after inspection reports are issued and installations comply with requirements.

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3.6 CLEANING AND PROTECTION

A. Clean off excess elastomeric fill materials adjacent to joints as the Work progresses by methods and with cleaning materials that are approved in writing by joint firestopping system manufacturers and that do not damage materials in which joints occur.

B. Provide final protection and maintain conditions during and after installation that ensure joint firestopping systems are without damage or deterioration at time of Substantial Completion. If damage or deterioration occurs despite such protection, cut out and remove damaged or deteriorated joint firestopping systems immediately and install new materials to produce joint firestopping systems complying with specified requirements.

3.7 JOINT FIRESTOPPING SYSTEM SCHEDULE

A. Where UL-classified systems are indicated, they refer to system numbers in UL's online directory "Product iQ" under product Category XHBN or Category XHDG.

B. Where Intertek Group-listed systems are indicated, they refer to design numbers in Intertek Group's "Directory of Building Products" under product category Expansion/Seismic Joints or Firestop Systems.

C. Floor-to-Floor, Joint Firestopping Systems: .

1. Assembly Rating: As indicated on drawings.
2. Nominal Joint Width: As indicated.
3. Movement Capabilities: Class II - 50 percent compression, extension, or horizontal shear.

D. Floor-to-Wall, Joint Firestopping Systems: .

1. Assembly Rating: As indicated on drawings.
2. Nominal Joint Width: As indicated.
3. Movement Capabilities: Class II - 50 percent compression, extension, or horizontal shear.

E. Head-of-Wall, Fire-Resistive Joint Firestopping Systems: .

1. Assembly Rating: As indicated on drawings.
2. Nominal Joint Width: As indicated.
3. Movement Capabilities: Class II - 50 percent compression or extension.

F. Bottom-of-Wall, Joint Firestopping Systems: .

1. Assembly Rating: As indicated on drawings.
2. Nominal Joint Width: As indicated.
3. Movement Capabilities: Class II - 50 percent compression or extension.

G. Wall-to-Wall, Joint Firestopping Systems Intended for Use as Corner Guards: .

1. Assembly Rating: As indicated on drawings.
2. Nominal Joint Width: As indicated.
3. Movement Capabilities: Class II - 50 percent compression or extension.

H. Perimeter Joint Firestopping Systems: .

1. Integrity Rating: As indicated on drawings.
2. Linear Opening Width: As indicated, maximum.
3. Movement Capabilities: Class II - 50 percent compression or extension.

END OF SECTION 07 84 43

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SECTION 07 92 00 - JOINT SEALANTS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Silicone joint sealants.
2. Latex joint sealants.
3. Joint sealant backings.

B. Related Requirements:

1. Section 079219 "Acoustical Joint Sealants" for sealing joints in sound-rated construction.

1.2 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of specified product.

1. Include preparation requirements and installation instructions.
2. Indicate VOC content.

B. Samples for Initial Selection: Manufacturer's standard color charts consisting of strips of cured sealants showing the full range of colors available for each product exposed to view.

C. Samples for Verification: For each type and color of joint sealant required, provide Samples with joint sealants in **1/2-inch-** wide joints formed between two **6-inch-** long strips of material matching the appearance of exposed surfaces adjacent to joint sealants.

D. Joint Sealant Schedule: Include the following information:

1. Joint sealant application, joint location, and designation.
2. Joint sealant manufacturer and product name.
3. Joint sealant formulation.
4. Joint sealant color.
5. Joint sealant backing or joint filler.
6. Joint size (width and depth).
7. Tooled joint profile.

1.4 INFORMATIONAL SUBMITTALS

A. Preconstruction Laboratory Test Schedule: Include the following information for each joint sealant and substrate material to be tested:

1. Joint sealant location and designation.
2. Manufacturer and product name.
3. Type of substrate material.
4. Proposed test.
5. Number of samples required.

B. Preconstruction Laboratory Test Reports: Reports from joint sealant manufacturer(s) for each joint sealant and substrate material to be tested indicating the following:

1. Verification that materials forming joint substrates and joint sealant backings have been tested for compatibility and adhesion with joint sealants.
2. Include interpretation of test results and written recommendations for primers and substrate

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preparation that are needed for adhesion.

C. Preconstruction Field-Adhesion-Test Reports: Indicate which sealants and joint preparation methods resulted in optimum adhesion to joint substrates based on testing specified in "Preconstruction Testing" Article.

D. Qualification Statements: For Installer and testing agency.

E. Field Quality Control Reports: For specified tests and inspections, for each sealant application tested.

F. Sample Warranties: For specified special warranties.

1.5 CLOSEOUT SUBMITTALS

A. Warranty Documentation:

1. Manufacturers' special warranties.
2. Installer's special warranties.

1.6 QUALITY ASSURANCE

A. Installer Qualifications: Authorized representative who is trained and approved by manufacturer.

B. Testing Agency Qualifications: Qualified in accordance with ASTM C1021 to conduct the testing indicated.

1.7 MOCKUPS

A. Install sealant in mockups of assemblies specified in other Sections that are indicated to receive joint sealants specified in this Section. Use materials and installation methods specified in this Section.

1.8 PRECONSTRUCTION TESTING

A. Preconstruction Laboratory Testing: Submit to joint sealant manufacturers, for testing indicated below, samples of materials that will contact or affect joint sealants.

1. Adhesion Testing: Use ASTM C794 to determine whether priming and other specific joint preparation techniques are required to obtain rapid, optimum adhesion of joint sealants to joint substrates.
2. Compatibility Testing: Use ASTM C1087 to determine sealant compatibility when in contact with glazing and gasket materials.
3. Stain Testing: Use ASTM C1248 to determine stain potential of sealant when in contact with stone substrates.
4. Submit manufacturer's recommended number of pieces of each type of material, including joint substrates, joint sealant backings, and miscellaneous materials.
5. Schedule sufficient time for testing and analyzing results to prevent delaying the Work.
6. For materials failing tests, obtain joint sealant manufacturer's written instructions for corrective measures, including use of specially formulated primers.
7. Testing will not be required if joint sealant manufacturers submit data that are based on previous testing, not older than 24 months, of sealant products for adhesion to, staining of, and compatibility with joint substrates and other materials matching those submitted.

B. Preconstruction Field-Adhesion Testing: Before installing sealants, field test their adhesion to Project joint substrates as follows:

1. Locate test joints where indicated on Project or, if not indicated, as directed by Architect.
2. Conduct field tests for each kind of sealant and joint substrate.
3. Notify Architect seven days in advance of dates and times when test joints will be erected.
4. Arrange for tests to take place with joint sealant manufacturer's technical representative present.
5. Test Method: Test joint sealants in accordance with Method A, Tail Procedure, in ASTM C1521.

a. For joints with dissimilar substrates, verify adhesion to each substrate separately; extend

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cut along one side, verifying adhesion to opposite side. Repeat procedure for opposite side.

6. Report whether sealant failed to adhere to joint substrates or tore cohesively. Include data on pull distance used to test each kind of product and joint substrate. For sealants that fail adhesively, retest until satisfactory adhesion is obtained.
7. Evaluation of Preconstruction Field-Adhesion-Test Results: Sealants not evidencing adhesive failure from testing, in absence of other indications of noncompliance with requirements, will be considered satisfactory. Do not use sealants that fail to adhere to joint substrates during testing.

1.9 FIELD CONDITIONS

A. Do not proceed with installation of joint sealants under the following conditions:

1. When ambient and substrate temperature conditions are outside limits permitted by joint sealant manufacturer or are below 40 deg F.
2. When joint substrates are wet.
3. Where joint widths are less than those allowed by joint sealant manufacturer for applications indicated.
4. Where contaminants capable of interfering with adhesion have not yet been removed from joint substrates.

1.10 WARRANTY

A. Special Installer's Warranty: Installer agrees to repair or replace joint sealants that do not comply with performance and other requirements specified in this Section within specified warranty period.

1. Warranty Period: Two years from date of Substantial Completion.

B. Special Manufacturer's Warranty: Manufacturer agrees to furnish joint sealants to repair or replace those joint sealants that do not comply with performance and other requirements specified in this Section within specified warranty period.

1. Warranty Period: Five years from date of Substantial Completion.

C. Special warranties specified in this article exclude deterioration or failure of joint sealants from the following:

1. Movement of the structure caused by stresses on the sealant exceeding sealant manufacturer's written specifications for sealant elongation and compression.
2. Disintegration of joint substrates from causes exceeding design specifications.
3. Mechanical damage caused by individuals, tools, or other outside agents.
4. Changes in sealant appearance caused by accumulation of dirt or other atmospheric contaminants.

PART 2 - PRODUCTS

2.1 SOURCE LIMITATIONS

A. Obtain joint sealants from single manufacturer for each sealant type.

2.2 JOINT SEALANTS, GENERAL

A. Provide joint sealants, backings, and other related materials that are compatible with one another and with joint substrates under conditions of service and application indicated, and as indicated within approved joint sealant schedule submittal based on joint sealant manufacturer's testing and field experience.

B. Colors of Exposed Joint Sealants: As selected by Architect from manufacturer's full range.

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2.3 SILICONE JOINT SEALANTS

A. Silicone, Neutral-Curing Sealant (All exterior joints to be Dow Corning 790 or 795): ASTM C920.

1. Basis-of-Design Product: Subject to compliance with requirements, provide Dow Corning 790 or 795 or comparable product by one of the following:

   a. Pecora Corporation
   b. Sika Corporation - Building Components
   c. The Dow Chemical Company

2. Uses:

   a. Dow Corning Corporation: 790 for sealing joints at dissimilar materials
   b. Dow Corning Corporation: 795 for sealing metal to metal or glass to glass joints

3. Type: S.
4. Grade: NS.
5. Class: 100/50.
6. Use: T and NT.

2.4 NONSTAINING SILICONE JOINT SEALANTS

A. General: No staining of substrates when tested in accordance with ASTM C1248.

2.5 LATEX JOINT SEALANTS

A. Acrylic Latex Sealant (For interior joints only.): ASTM C834.

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. Adfast
   b. Everkem Diversified Products, Inc.
   c. Franklin International
   d. Pecora Corporation
   e. Sherwin-Williams Company (The)
   f. The Pittsburgh Paints Company
   g. Tremco Incorporated

2. Type: OP.
3. Grade: NF.

2.6 JOINT SEALANT ACCESSORIES

A. Joint Sealant Backings: Provide joint sealant backings that are nonstaining, compatible with joint substrates, sealants, primers, and other joint fillers under conditions of service and application indicated, and as indicated within approved joint sealant schedule submittal based on joint sealant manufacturer's testing and field experience.

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. Adfast
   b. Alcot Plastics Ltd.
   c. Construction Foam Products; a division of Nomaco, Inc.

2. Cylindrical Sealant Backings: ASTM C1330, of size and density to control sealant depth and otherwise contribute to producing optimum sealant performance.

   a. Classification: Type C as approved in writing by joint sealant manufacturer for joint application indicated.

B. Bond-Breaker Tape : Polyethylene tape or other plastic tape recommended in writing by joint sealant

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manufacturer for preventing sealant from adhering to rigid, inflexible joint-filler materials, or joint surfaces at back of joint. Provide self-adhesive tape where applicable.

2.7 MISCELLANEOUS MATERIALS

A. Primer: Material recommended in writing by joint sealant manufacturer where required for adhesion of sealant to joint substrates indicated, as determined from preconstruction joint sealant-substrate tests and field tests.

B. Cleaners for Nonporous Surfaces: Chemical cleaners acceptable to manufacturers of sealants and sealant backing materials, free of oily residues or other substances capable of staining or harming joint substrates and adjacent nonporous surfaces in any way, and formulated to promote optimum adhesion of sealants to joint substrates.

C. Masking Tape: Nonstaining, nonabsorbent material compatible with joint sealants and surfaces adjacent to joints.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine joints indicated to receive joint sealants, with Installer present, for compliance with requirements for joint configuration, installation tolerances, and other conditions affecting performance of the Work.

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

3.2 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. Porous Joint Substrate Surfaces: Clean by brushing, grinding, mechanical abrading, or a combination of these methods to produce a clean, sound substrate capable of developing optimum bond with joint sealants. Remove loose particles remaining after cleaning operations above by vacuuming or blowing out joints with oil-free compressed air. Porous joint substrates include the following:

    a. Concrete.
    b. Masonry.
    c. Unglazed surfaces of ceramic tile.
    d. Exterior insulation and finish systems.

3. Concrete Substrate Surfaces: Remove laitance and form-release agents from concrete.
4. Nonporous Joint Substrate Surfaces: Clean with chemical cleaners or other means that do not stain, harm substrates, or leave residues capable of interfering with adhesion of joint sealants. Nonporous joint substrates include the following:

    a. Metal.
    b. Glass.
    c. Porcelain enamel.
    d. Glazed surfaces of ceramic tile.

B. Joint Priming: Prime joint substrates where recommended by joint sealant manufacturer or as indicated by preconstruction joint sealant-substrate tests or prior experience. Apply primer to comply with joint sealant manufacturer's written instructions. Confine primers to areas of joint sealant bond; do not allow spillage or migration onto adjoining surfaces.

C. Masking Tape: Use masking tape where required to prevent contact of sealant or primer with adjoining

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surfaces that otherwise would be permanently stained or damaged by such contact or by cleaning methods required to remove sealant smears. Remove tape immediately after tooling without disturbing joint seal.

3.3 INSTALLATION OF JOINT SEALANTS

A. General: Comply with joint sealant and backing manufacturer's written installation instructions for products and applications indicated, unless more stringent requirements apply.

B. Sealant Installation Standard: Comply with recommendations in ASTM C1193 for use of joint sealants as applicable to materials, applications, and conditions indicated.

C. Joint Sealant Backings: Install 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.

1. Do not leave gaps between ends of sealant backings.
2. Do not stretch, twist, puncture, or tear sealant backings.
3. Remove absorbent sealant backings that have become wet before sealant application and replace them with dry materials.

D. Bond-Breaker Tape: Install tape behind sealants where sealant backings are not used between sealants and backs of joints.

E. Joint Sealants: Install using proven techniques that comply with the following and at the same time backings are installed:

1. Place sealants so they directly contact and fully wet joint substrates.
2. Completely fill recesses in each joint configuration.
3. Produce uniform, cross-sectional shapes and depths relative to joint widths that allow optimum sealant movement capability.

F. Tooling of Nonsag Sealants: Immediately after sealant application and before skinning or curing begins, tool sealants in accordance with requirements specified in subparagraphs below to form smooth, uniform beads of configuration indicated; to eliminate air pockets; and to ensure contact and adhesion of sealant with sides of joint.

1. Remove excess sealant from surfaces adjacent to joints.
2. Use tooling agents that are approved in writing by sealant manufacturer and that do not discolor sealants or adjacent surfaces.
3. Provide concave joint profile in accordance with Figure 8A in ASTM C1193 unless otherwise indicated.
4. Provide flush joint profile at locations indicated on Drawings in accordance with Figure 8B in ASTM C1193.
5. Provide recessed joint configuration of recess depth and at locations indicated on Drawings in accordance with Figure 8C in ASTM C1193.

    a. Use masking tape to protect surfaces adjacent to recessed tooled joints.

3.4 FIELD QUALITY CONTROL

A. Testing Agency: Owner will engage a qualified testing agency to perform tests and inspections.

B. Tests and Inspections:

1. Field-Adhesion Testing: Field test joint sealant adhesion to joint substrates as follows:

    a. Extent of Testing: Test completed and cured sealant joints as follows:

        1) Perform 10 tests for the first 1000 ft. of joint length for each kind of sealant and joint substrate.
        2) Perform one test for each 1000 ft. of joint length thereafter or one test per each floor per elevation.

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b. Test Method: Test joint sealants in accordance with Method A, Tail Procedure, in ASTM C1521.

1) For joints with dissimilar substrates, verify adhesion to each substrate separately; extend cut along one side, verifying adhesion to opposite side. Repeat procedure for opposite side.

c. Inspect tested joints and report on the following:

1) Whether sealants filled joint cavities and are free of voids.
2) Whether sealant dimensions and configurations comply with specified requirements.
3) Whether sealants in joints connected to pulled-out portion failed to adhere to joint substrates or tore cohesively. Include data on pull distance used to test each kind of product and joint substrate. Compare these results to determine if adhesion complies with sealant manufacturer's field-adhesion hand-pull test criteria.

d. Record test results in a field-adhesion-test log. Include dates when sealants were installed, names of persons who installed sealants, test dates, test locations, whether joints were primed, adhesion results and percent elongations, sealant material, sealant configuration, and sealant dimensions.

e. Repair sealants pulled from test area by applying new sealants following same procedures used originally to seal joints. Ensure that original sealant surfaces are clean and that new sealant contacts original sealant.

2. Evaluation of Field-Adhesion-Test Results: Sealants not evidencing adhesive failure from testing or noncompliance with other indicated requirements will be considered satisfactory. Remove sealants that fail to adhere to joint substrates during testing or to comply with other requirements. Retest failed applications until test results prove sealants comply with indicated requirements.

C. Prepare test and inspection reports.

3.5 CLEANING

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

3.6 PROTECTION

A. Protect joint sealants during and after curing period from contact with contaminating substances and from damage resulting from construction operations or other causes so sealants are without deterioration or damage at time of Substantial Completion. If, despite such protection, damage or deterioration occurs, cut out, remove, and repair damaged or deteriorated joint sealants immediately so installations with repaired areas are indistinguishable from original work.

3.7 JOINT SEALANT SCHEDULE

A. Exterior Joints in Horizontal Traffic Surfaces:

1. Joint Locations:

a. Control and expansion joints in brick pavers.
b. Isolation and contraction joints in cast-in-place concrete slabs.
c. Joints between plant-precast architectural concrete paving units.
d. Joints in stone paving units , including steps.
e. Tile control and expansion joints.
f. Joints between different materials listed above.
g. Other joints as indicated on Drawings.

2. Color: As selected by Architect from manufacturer's full range of colors.

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B. Exterior Joints in Horizontal Traffic Surfaces Subject to Water Immersion:

1. Joint Locations:

   a. Joints in pedestrian plazas.
   b. Joints in swimming pool decks.
   c. Other joints as indicated on Drawings.

2. Color: As selected by Architect from manufacturer's full range of colors.

C. Exterior Joints in Vertical Surfaces and Horizontal Nontraffic Surfaces:

1. Joint Locations:

   a. Construction joints in cast-in-place concrete.
   b. Joints between plant-precast architectural concrete units.
   c. Control and expansion joints in unit masonry.
   d. Joints in dimension stone cladding.
   e. Joints in glass unit masonry assemblies.
   f. Joints in exterior insulation and finish systems.
   g. Joints between metal panels.
   h. Joints between different materials listed above.
   i. Perimeter joints between materials listed above and frames of doors windows and louvers.
   j. Control and expansion joints in ceilings and other overhead surfaces.
   k. Other joints as indicated on Drawings.

2. Color: As selected by Architect from manufacturer's full range of colors.

D. Interior Joints in Horizontal Traffic Surfaces:

1. Joint Locations:

   a. Isolation joints in cast-in-place concrete slabs.
   b. Control and expansion joints in stone flooring.
   c. Control and expansion joints in brick flooring.
   d. Control and expansion joints in tile flooring.
   e. Other joints as indicated on Drawings.

2. Color: As selected by Architect from manufacturer's full range of colors.

E. Interior Joints in Vertical Surfaces and Horizontal Nontraffic Surfaces:

1. Joint Locations:

   a. Control and expansion joints on exposed interior surfaces of exterior walls.
   b. Tile control and expansion joints.
   c. Vertical joints on exposed surfaces of unit masonry concrete walls.
   d. Joints on underside of plant-precast structural concrete beams.
   e. Other joints as indicated on Drawings.

2. Color: As selected by Architect from manufacturer's full range of colors.

F. Interior Joints in Vertical Surfaces and Horizontal Nontraffic Surfaces Not Subject to Significant Movement:

1. Joint Locations:

   a. Control joints on exposed interior surfaces of exterior walls.
   b. Perimeter joints between interior wall surfaces and frames of interior doors windows and elevator entrances.
   c. Other joints as indicated on Drawings.

2. Color: As selected by Architect from manufacturer's full range of colors.

G. Concealed Mastics:

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1. Joint Locations:

    a. Aluminum thresholds.
    b. Sill plates.
    c. Other joints as indicated on Drawings.

END OF SECTION 07 92 00

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SECTION 07 92 19 - ACOUSTICAL JOINT SEALANTS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Acoustical joint sealants.

B. Related Requirements:

1. Section 079200 "Joint Sealants" for elastomeric, latex, and butyl-rubber-based joint sealants for nonacoustical applications.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of specified product.

B. Samples for Initial Selection: Manufacturer's color charts consisting of strips of cured sealants, showing full range of available colors for each product exposed to view.

C. Samples for Verification: For each type and color of acoustical joint sealant required.

1. Size: **1/2-inch-** wide sealant joints formed between two **6-inch-** long strips of material matching the appearance of exposed surfaces adjacent to joint sealants.

D. Acoustical Joint Sealant Schedule: Include the following information:

1. Joint sealant application, joint location, and designation.
2. Joint sealant manufacturer and product name.
3. Joint sealant formulation.
4. Joint sealant color.

1.3 INFORMATIONAL SUBMITTALS

A. Product Test Reports: For each type of acoustical joint sealant, for tests performed by qualified testing agency.

B. Sample Warranties: For specified special warranties.

1.4 CLOSEOUT SUBMITTALS

A. Warranty Documentation:

1. Manufacturers' special warranties.
2. Installer's special warranties.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Store materials not in use in tightly covered containers in well-ventilated areas with ambient temperatures continuously maintained between **40 and 95 deg F**.

1. Maintain containers in clean condition, free of foreign materials and residue.
2. Remove rags and waste from storage areas daily.

1.6 FIELD CONDITIONS

A. Install joint sealant only when temperature of surfaces to be sealed and ambient air temperatures are in accordance with acoustical joint sealant manufacturer's written installation instructions

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1.7 WARRANTY

A. Installer's Special Warranty: Installer agrees to repair or replace acoustical joint sealants that do not comply with performance and other requirements specified in this Section within specified warranty period.

1. Warranty Period: Two years from date of Substantial Completion.

B. Manufacturer's Special Warranty: Manufacturer agrees to furnish acoustical joint sealants to repair or replace those joint sealants that do not comply with performance and other requirements specified in this Section within specified warranty period.

1. Warranty Period: Five years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 ACOUSTICAL JOINT SEALANTS

A. General: Acoustical joint-sealant products that effectively reduce airborne sound transmission through perimeter joints and openings in building construction, as demonstrated by testing representative assemblies in accordance with ASTM E90.

B. Acoustical Sealant for Exposed and Concealed Joints: Manufacturer's standard nonsag, paintable, nonstaining latex acoustical sealant complying with ASTM C834.

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. DAP Products Inc.
b. Everkem Diversified Products, Inc.
c. Franklin International
d. Grabber Construction Products, Inc.
e. Hilti, Inc.
f. OSI Sealants; Henkel Corporation
g. Pecora Corporation
h. Specified Technologies Inc.
i. USG Corporation

2. Colors of Exposed Acoustical Joint Sealants: As selected by Architect from manufacturer's full range of colors.

C. Acoustical Sealant for Concealed Joints: Manufacturer's standard nonsag, nondrying, nonhardening, nonskinning, nonstaining, gunnable, synthetic-rubber acoustical sealant.

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. OSI Sealants; Henkel Corporation
b. Pecora Corporation
c. Tremco Incorporated
d. USG Corporation

2.2 MISCELLANEOUS MATERIALS

A. Primer: Material recommended by acoustical joint sealant manufacturer where required for adhesion of sealant to joint substrates.

B. Cleaners for Nonporous Surfaces: Chemical cleaners acceptable to manufacturers of sealants and sealant backing materials, free of oily residues or other substances capable of staining or harming joint substrates and adjacent nonporous surfaces in any way, and formulated to promote optimum adhesion of sealants to joint substrates.

C. Masking Tape: Nonstaining, nonabsorbent material compatible with joint sealants and surfaces

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adjacent to joints.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine joints indicated to receive acoustical joint sealants, with Installer present, for compliance with requirements for joint configuration, installation tolerances, and other conditions affecting performance of the Work.

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

3.2 PREPARATION

A. Surface Cleaning of Joints: Clean out joints immediately before installing acoustical joint sealants to comply with joint sealant manufacturer's written instructions.

B. Joint Priming: Prime joint substrates where recommended by acoustical 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 or primer with adjoining surfaces that otherwise would be permanently stained or damaged by such contact or by cleaning methods required to remove sealant smears. Remove tape immediately after tooling without disturbing joint seal.

3.3 INSTALLATION OF ACOUSTICAL JOINT SEALANTS

A. Comply with acoustical joint sealant manufacturer's written installation instructions.

B. STC-Rated Assemblies: Seal construction at perimeters, behind control joints, and at openings and penetrations with a continuous bead of acoustical joint sealant. Install acoustical joint sealants at both faces of partitions, at perimeters, and through penetrations. Comply with ASTM C919, ASTM C1193, and manufacturer's written instructions for closing off sound-flanking paths around or through assemblies, including sealing partitions to underside of floor slabs above acoustical ceilings.

C. Acoustical Ceiling Areas: Apply acoustical joint sealant at perimeter edge moldings of acoustical ceiling areas in a continuous ribbon concealed on back of vertical legs of moldings before they are installed.

3.4 CLEANING

A. Clean off excess sealant or sealant smears adjacent to joints as the Work progresses by methods and with cleaning materials approved in writing by manufacturer of acoustical joint sealants and of products in which joints occur.

3.5 PROTECTION

A. Protect acoustical joint sealants during and after curing period from contact with contaminating substances and from damage resulting from construction operations or other causes so sealants are without deterioration or damage at time of Substantial Completion. If, despite such protection, damage or deterioration occurs, cut out, remove, and repair damaged or deteriorated acoustical joint sealants immediately so installations with repaired areas are indistinguishable from original work.

END OF SECTION 07 92 19

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SECTION 08 11 13 - HOLLOW METAL DOORS AND FRAMES

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Standard exterior hollow metal doors and frames.
2. Standard interior hollow metal doors and frames.
3. Borrowed lite frames.

B. Related Requirements:

1. Section 081119 "Stainless-Steel Doors and Frames" for hollow metal doors and frames manufactured from stainless steel.
2. Section 083473.13 "Metal Sound Control Door Assemblies" for packaged, acoustically rated, hollow metal door and frame assemblies.
3. Section 087100 "Door Hardware" for door hardware for hollow metal doors.
4. Section 119812 "Detention Doors and Frames" for hollow metal doors and frames for detention facilities.
5. Section 134900 "Radiation Protection" for lead-lined, hollow metal doors and frames.

1.2 COORDINATION

A. Coordinate installing anchors for hollow metal frames, including sleeves, concrete inserts, and anchor bolts.

B. Coordinate requirements for installing door hardware, including electrified door hardware, and access control and security systems.

1.3 DEFINITIONS

A. Minimum Steel Sheet Thickness: Minimum thickness of base metal without coatings in accordance with ANSI/SDI A250.8.

1.4 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1.5 ACTION SUBMITTALS

A. Product Data: For each type of specified product.

1. Include construction details, material descriptions, core descriptions, and finishes.
2. Include information indicating compliance with performance requirements indicated.

B. Shop Drawings:

1. Elevations of each door type.
2. Details of doors, including vertical- and horizontal-edge details and base-metal thicknesses.
3. Frame details for each frame type, including dimensioned profiles and base-metal thicknesses.
4. Locations of reinforcement and preparations for hardware.
5. Details of each wall opening condition.
6. Details of electrical raceway and preparation for electrified hardware, access control systems, and security systems.
7. Details of frame anchors, joints, field splices, and connections.
8. Details of accessories.
9. Details of moldings, removable stops, and glazing.

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C. Samples for Initial Selection: Manufacturer's standard color sheets, showing full range of available colors for doors and frames with factory-applied color finishes.

D. Samples for Verification: For factory applied color finishes, prepared on Samples of not less than 3 by 5 inches.

E. Product Schedule: For hollow metal doors and frames, prepared by or under the supervision of supplier, using same reference numbers for details and openings used on the Drawings and in schedules. Coordinate with final door hardware schedule.

1.6 INFORMATIONAL SUBMITTALS

A. Product Test Reports: For tests performed by a qualified testing agency for the following:

1. Fire-rated door assemblies.
2. Smoke- and draft-control door assemblies.
3. Fire-rated borrowed lite assemblies.
4. Windborne-debris impact resistant door assemblies.
5. Thermally rated door assemblies.

B. Oversize Construction Certification: For assemblies required to be fire-rated that exceed limitations of labeled assemblies.

1.7 CLOSEOUT SUBMITTALS

A. Record Documents: For fire-rated door assemblies, list of door numbers and applicable room name and number to which door provides access.

1.8 QUALITY ASSURANCE

A. Fire-Rated Door Inspector Qualifications: Documented as complying with requirements in NFPA 80 and having Door and Hardware Institute's Certified Fire + Egress Door Assembly Inspector (CFDAI) credentials.

B. Egress Door Inspector Qualifications: Documented as complying with requirements in NFPA 101 .

1.9 DELIVERY, STORAGE, AND HANDLING

A. Deliver hollow metal doors and frames palletized, packaged, or crated to provide protection during transit and Project-site storage. Do not use nonvented plastic, canvas, or other material that can entrap moisture.

1. Provide additional protection to prevent damage to factory-applied color finishes.

B. Deliver welded frames with two removable spreader bars across bottom of frames, tack welded to jambs and mullions.

C. Store hollow metal doors and frames vertically under cover at Project site with head up. Place on minimum **4-inch-** high wood blocking. Provide minimum **1/4-inch** space between each stacked door to permit air circulation.

D. Immediately remove and replace damaged or wet packaging or protective material.

PART 2 - PRODUCTS

2.1 SOURCE LIMITATIONS

A. Obtain hollow metal doors and frames from single manufacturer.

2.2 PERFORMANCE REQUIREMENTS

A. Fire-Rated Door Assemblies: Complying with requirements in NFPA 80 and listed and labeled by a

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qualified testing agency acceptable to authorities having jurisdiction for fire-protection ratings indicated on Drawings, based on testing at positive pressure in accordance with NFPA 252 or UL 10C.

1. Temperature-Rise Limit: Where indicated on Drawings, provide doors that have a maximum transmitted temperature end point of not more than **450 deg F** above ambient after 30 minutes of standard fire-test exposure.
2. Oversize Fire-Rated Door Assemblies: For units exceeding sizes of tested assemblies, provide certification by a qualified testing agency that doors comply with standard construction requirements for tested and labeled fire-rated door assemblies except for size.

B. Sidelite and Transom Frames: Assemblies complying with NFPA 80 and listed and labeled by a qualified testing agency acceptable to authorities having jurisdiction, for fire-protection ratings indicated on Drawings, based on testing in accordance with ASTM E119 or UL 263.

C. Smoke- and Draft-Control Door Assemblies: Listed and labeled for smoke and draft control based on testing in accordance with UL 1784 by a qualified testing agency acceptable to authorities having jurisdiction.

D. Fire-Rated, Borrowed-Lite Assemblies: Assemblies complying with NFPA 80 and listed and labeled by a qualified testing agency acceptable to authorities having jurisdiction, for fire-protection ratings indicated, based on testing in accordance with NFPA 257 or UL 9.

2.3 STANDARD EXTERIOR HOLLOW METAL DOORS AND FRAMES

A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1. Ceco Door; AADG, Inc.; ASSA ABLOY
2. Curries, AADG, Inc.; ASSA ABLOY Group
3. DCI Hollow Metal on Demand
4. DE LA FONTAINE
5. Deansteel Manufacturing Company, Inc.
6. Expi-Door Systems, Inc.
7. Hollow Metal Xpress
8. Mesker Door; Mesker Openings Group
9. MPI Group, LLC (The)
10. Pioneer Industries; AADG, Inc.; ASSA ABLOY
11. Premier Products, Inc
12. Republic Doors and Frames; an Allegion brand
13. Steelcraft; Allegion plc
14. Stiles Custom Metal, Inc

B. Exterior Heavy-Duty Doors and Frames: ANSI/SDI A250.8, Level 2; ANSI/SDI A250.4, Level B.

1. Steel Sheet: Minimum A60 metallic coating.
2. Doors: **1-3/4 inches** thick.

    a. Faces: Steel sheet; minimum **0.042-inch** base-metal thickness.
    b. Edge Construction: Model 2, Seamless.
    c. Edge Bevel: Provide manufacturer's standard beveled or square edges.
    d. End Closures: Steel sheet; minimum **0.042-inch** base-metal thickness. Flush top channel sealed against water penetration and flush bottom channel with weep-hole openings to permit moisture to escape.
    e. Cores: Manufacturer's standard.
    f. Fire-Rated Cores: Manufacturer's standard core required for fire rating indicated.

3. Frames: Steel sheet; minimum **0.053-inch** base-metal thickness.

    a. Construction: Full-profile welded.
    b. Sidelite and Transom Frames: Fabricated from same thickness material as adjacent door frame.

4. Exposed Finish: Prime painted.

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2.4 STANDARD INTERIOR HOLLOW METAL DOORS AND FRAMES

A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1. Ceco Door; AADG, Inc.; ASSA ABLOY
2. Curries, AADG, Inc.; ASSA ABLOY Group
3. DCI Hollow Metal on Demand
4. DE LA FONTAINE
5. Deansteel Manufacturing Company, Inc.
6. Expi-Door Systems, Inc.
7. Hollow Metal Xpress
8. Mesker Door; Mesker Openings Group
9. MPI Group, LLC (The)
10. Pioneer Industries; AADG, Inc.; ASSA ABLOY
11. Premier Products, Inc
12. Republic Doors and Frames; an Allegion brand
13. Steelcraft; Allegion plc
14. Stiles Custom Metal, Inc

B. Interior Standard-Duty Doors and Frames: ANSI/SDI A250.8, Level 1; ANSI/SDI A250.4, Level C.

1. Steel Sheet: Metallic coated.
2. Doors: 1-3/4 inches thick.

    a. Faces: Steel sheet; minimum **0.032-inch** base-metal thickness.
    b. Edge Construction: Model 1, Full Flush.
    c. Edge Bevel: Provide manufacturer's standard edges.
    d. End Closures: Steel sheet; minimum **0.042-inch** base-metal thickness; flush top channel and inverted bottom channel.
    e. Cores: Manufacturer's standard.
    f. Fire-Rated Cores: Manufacturer's standard core required for fire rating indicated.

3. Frames: Steel sheet; minimum **0.042-inch** base-metal thickness.

    a. Construction: Full-profile welded.
    b. Sidelite and Transom Frames: Fabricated from same thickness material as adjacent door frame.

4. Exposed Finish: Prime painted.

2.5 ACCESSORIES

A. Door Vision Lite Frames: Steel sheet matching door face material; minimum **0.032-inch** base-metal thickness.

1. Profile: Flush type, with square stops.
2. Corner Construction: Mitered and welded.
3. Fasteners: Countersunk.
4. Fixed-Stop Location: Secure (key) side of door.
5. Fire-Rated Doors: Comply with requirements in NFPA 80.

B. Hollow Metal Infill Panels: Match materials, construction, and finish of adjacent door.

C. Door Louvers: SDI 111C; steel sheet matching door face material.

1. Frames: Minimum 0.032-inch base-metal thickness. Provide fixed frame moldings with hairline joints at corners on outside of exterior and on secure (key) side of interior doors.
2. Sightproof Louver: Stationary louvers constructed with inverted-V or inverted-Y blades.

    a. Blades: Minimum 0.026-inch base-metal thickness.

3. Lightproof Louver: Stationary louvers constructed with baffles to prevent light from passing from one side to the other.

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a. Baffles: Minimum 0.026-inch base-metal thickness.

4. Fire-Rated Automatic Louvers: Constructed with movable blades closed by actuating fusible link; listed and labeled for use in fire-rated door assemblies of type and fire-resistance rating indicated by same qualified testing and inspecting agency that established fire-resistance rating of door assembly.

D. Frame Anchors: ANSI/SDI 250.4; steel sheet; minimum base-metal thickness required by door and frame standard indicated.

1. Interior Locations: ASTM A1008/A1008M or ASTM A1011/A1011M; hot-dip galvanized in accordance with ASTM A153/A153M, Class B.
2. Exterior-Wall Anchors: ASTM A653/653M, A60 metallic coating.
3. Jamb Anchors: Of minimum size and type required by door and frame standard indicated, and suitable for performance level indicated.

a. Quantity: Minimum of three anchors per jamb, with one additional anchor for frames with no floor anchor. Provide one additional anchor for each **24 inches** of frame height above **7 ft.**.
b. Postinstalled Expansion Anchor: Minimum **3/8-inch-** diameter bolts with expansion shields or inserts, with manufacturer's standard pipe spacer.

4. Floor Anchors: Provide floor anchors for each jamb and mullion that extends to floor.
5. Floor Anchors for Concrete Slabs with Underlayment: Adjustable-type anchors with extension clips that allow **2-inch** height adjustment. Terminate bottom of frames at top of underlayment.

2.6 MATERIALS

A. Recycled Content of Steel Products: Postconsumer recycled content plus one-half of preconsumer recycled content not less than 25 percent.

B. Cold-Rolled Steel Sheet: ASTM A1008/A1008M, Commercial Steel (CS), Type B; suitable for exposed applications.

C. Hot-Rolled Steel Sheet: ASTM A1011/A1011M, Commercial Steel (CS), Type B; free of scale, pitting, or surface defects; pickled and oiled.

D. Metallic-Coated Steel Sheet: ASTM A653/A653M, Commercial Steel (CS), Type B.

E. Inserts, Bolts, and Fasteners: Hot-dip galvanized in accordance with ASTM A153/A153M.

F. Power-Actuated Fasteners in Concrete: Fastener system of type suitable for application indicated, fabricated from corrosion-resistant materials, with clips or other accessory devices for attaching hollow metal frames of type indicated.

G. Mineral-Fiber Insulation: ASTM C665, Type I (blankets without membrane facing); consisting of fibers manufactured from slag or rock wool; with maximum flame-spread and smoke-developed indexes of 25 and 50, respectively; passing ASTM E136 for combustion characteristics.

H. Glazing: Comply with requirements in Section 088000 "Glazing."

2.7 FABRICATION

A. Door Astragals: Provide overlapping astragal on one leaf of pairs of doors where required by NFPA 80 for fire-performance rating indicated. Extend minimum **3/4 inch** beyond edge of door on which astragal is mounted or as required to comply with published listing of qualified testing agency.

B. Hollow Metal Frames:

1. Welded Frames: Fabricate in one piece except where handling and shipping limitations require multiple sections. Where frames are fabricated in sections, provide alignment plates or angles, at each joint, fabricated from metal of same or greater thickness as frames.
2. Sidelite and Transom Bar Frames: Provide closed tubular members with no visible face seams or joints fabricated from same material as door frame. Fasten members at crossings and to

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jambs by welding , or by rigid mechanical anchors.

3. Provide countersunk, flat- or oval-head exposed screws and bolts for exposed fasteners unless otherwise indicated.
4. Door Silencers: Except on weather-stripped frames, drill stops to receive door silencers. Keep holes clear during construction.

    a. Single-Door Frames: Drill stop in strike jamb to receive three door silencers.
    b. Double-Door Frames: Drill stop in head jamb to receive two door silencers.

5. Terminated Stops (Hospital Stops): Terminate stops 6 inches above finish floor with a 45 - degree angle cut, and close open end of stop with steel sheet closure. Cover opening in extension of frame with welded-steel filler plate, with welds ground smooth and flush with frame.
6. Thermally Broken Frames: Provide manufacturer's standard frame construction with a split running continuously along the frame length, filled with an insert of low-thermal conducting material joining the two portions.

C. Hardware Preparation: Factory prepare hollow metal doors and frames to receive templated mortised hardware, and electrical wiring; include cutouts, reinforcement, mortising, drilling, and tapping in accordance with ANSI/SDI A250.6, the door hardware required, and templates.

1. Reinforce doors and frames to receive nontemplated, mortised, and surface-mounted door hardware.
2. Comply with ANSI/SDI A250.14 for preparing hollow metal doors and frames for hardware.

D. Door Vision Lite Frames:

1. Multiple Glazed Lites: Provide fixed and removable stops and moldings so that each glazed lite is capable of being removed independently.
2. Rabbets: Coordinate width between fixed and removable stops with glazing and installation types indicated.
3. Fastener Spacing: Not more than **9 inches** o.c. and not more than **2 inches** from each corner.

2.8 STEEL FINISHES

A. Prime Finish: Clean, pretreat, and apply manufacturer's standard primer.

1. Shop Primer: Manufacturer's standard, fast-curing, lead- and chromate-free primer complying with ANSI/SDI A250.10; recommended by primer manufacturer for substrate; compatible with substrate and field-applied coatings despite prolonged exposure.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates and conditions, with Installer present, for compliance with requirements and other conditions affecting performance of the Work.

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

3.2 PREPARATION

A. Remove welded-in shipping spreaders installed at factory. Restore exposed finish by grinding, filling, and dressing, as required to make repaired area smooth, flush, and invisible on exposed faces. Touch up factory-applied finishes where spreaders are removed.

B. Drill and tap doors and frames to receive nontemplated, mortised, and surface-mounted door hardware.

3.3 INSTALLATION OF STANDARD EXTERIOR HOLLOW METAL DOORS AND FRAMES

A. Install in accordance with ANSI/SDI A250.8 and ANSI/SDI A250.11.

B. Fire-Rated Hollow Metal Doors and Frames: Install in accordance with NFPA 80.

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C. Smoke- and Draft-Control Hollow Metal Doors and Frames: Install in accordance with NFPA 105.

D. Install hollow metal doors and frames plumb, rigid, properly aligned, and securely fastened in place. Comply with approved Shop Drawings and with manufacturer's written instructions.

E. Mineral-Fiber Insulation: Solidly pack mineral-fiber insulation inside frames.

F. Glazing: Comply with installation requirements in Section 088000 "Glazing" and with hollow metal door and frame manufacturer's written instructions.

3.4 INSTALLATION OF STANDARD INTERIOR HOLLOW METAL DOORS AND FRAMES

A. Install in accordance with ANSI/SDI A250.8 and ANSI/SDI A250.11.

B. Fire-Rated Hollow Metal Doors and Frames: Install in accordance with NFPA 80.

C. Smoke- and Draft-Control Hollow Metal Doors and Frames: Install in accordance with NFPA 105.

D. Install hollow metal doors and frames plumb, rigid, properly aligned, and securely fastened in place. Comply with approved Shop Drawings and with manufacturer's written instructions.

E. Mineral-Fiber Insulation: Solidly pack mineral-fiber insulation inside frames.

F. Glazing: Comply with installation requirements in Section 088000 "Glazing" and with hollow metal door and frame manufacturer's written instructions.

3.5 INSTALLATION OF BORROWED LITE FRAMES

A. Install in accordance with ANSI/SDI A250.8 and ANSI/SDI A250.11.

B. Mineral-Fiber Insulation: Solidly pack mineral-fiber insulation inside frames.

C. Glazing: Comply with installation requirements in Section 088000 "Glazing" and with hollow metal door and frame manufacturer's written instructions.

3.6 FIELD QUALITY CONTROL

A. Inspection Agency: Owner will engage a qualified inspector to perform tests and inspections and to furnish reports to Architect.

B. Fire-Rated Door Acceptance Testing: Test and inspect fire-rated doors in accordance with NFPA 80.

C. Smoke- and Draft-Control Door Acceptance Testing: Test and inspect smoke- and draft-control door assemblies in accordance with NFPA 105.

D. Egress-Door Acceptance Testing: Test and inspect egress doors in accordance with NFPA 101.

E. Repair or remove and replace installations where testing and inspections indicate noncompliance with specified requirements.

F. Reinspect repaired or replaced installations to determine if replaced or repaired door assembly installations comply with specified requirements.

G. Inspection Report: Prepared and submitted in writing to Architect and Contractor within 24 hours after testing.

3.7 ADJUSTING

A. Remove and replace defective work, including frames that are warped, bowed, or otherwise defective.

B. Prime-Coat Touchup: Immediately after erection, sand smooth rusted or damaged areas of prime coat and apply touchup of compatible air-drying, rust-inhibitive primer.

C. Metallic-Coated Surface Touchup: Clean abraded areas and repair with galvanizing repair paint in accordance with manufacturer's written instructions.

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D. Factory-Applied Color Finish Touchup: Clean abraded areas and repair with same material used for factory finish in accordance with manufacturer's written instructions.

END OF SECTION 08 11 13

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SECTION 08 14 16 - FLUSH WOOD DOORS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Solid-core five-ply flush wood veneer-faced doors and transom panels for transparent finish.

B. Related Requirements:

1. Section 087100 "Door Hardware" for door hardware for flush wood doors.
2. Section 088000 "Glazing" for glass view panels in flush wood doors.
3. Section 099113 "Exterior Painting" Section 099124 "Interior Painting (MPI Standards)" for field finishing doors.

1.2 COORDINATION

A. Coordinate requirements for installing door hardware, including electrified door hardware, and access control and security systems.

1.3 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of specified product. Include information indicating compliance with performance requirements indicated.

1. Door core materials and construction.
2. Door edge construction.
3. Door face type and characteristics.
4. Door louvers.
5. Door trim for openings.
6. Door frame construction.
7. Factory-machining criteria.
8. Factory- finishing specifications.

B. Shop Drawings: Indicate location, size, and hand of each door; elevation of each type of door; construction details not covered in product data; and the following:

1. Door schedule indicating door and frame location, type, size, fire protection rating, and swing.
2. Door elevations, dimension and locations of hardware, lite and louver cutouts, and glazing thicknesses.
3. Details of frame for each frame type, including dimensions and profile.
4. Details of electrical raceway and preparation for electrified hardware, access control systems, and security systems.
5. Dimensions and locations of blocking for hardware attachment.
6. Dimensions and locations of mortises and holes for hardware.
7. Clearances and undercuts.
8. Requirements for veneer matching.
9. Doors to be factory finished and application requirements.

C. Samples for Initial Selection: For factory-finished doors.

D. Samples for Verification:

1. Factory finishes applied to actual door face materials, approximately **8 by 10 inches**, for each material and finish. For each wood species and transparent finish, provide set of three

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Samples showing typical range of color and grain to be expected in finished Work.
2. Plastic-laminate, **6 inches** square, for each color, texture, and pattern selected.
3. Polymer edging, in manufacturer's standard colors.
4. Corner sections of doors, approximately **8 by 10 inches**, with door faces and edges representing actual materials to be used.
5. Louver blade and frame sections, **6 inches** long, for each material and finish specified.
6. Frames for light openings, **6 inches** long, for each material, type, and finish required.

1.5 INFORMATIONAL SUBMITTALS

A. Product Test Reports: For tests performed by a qualified testing agency for the following:

1. Fire-rated door assemblies.
2. Smoke- and draft-control door assemblies.

B. Oversize Construction Certification: For assemblies required to be fire-rated that exceed limitations of labeled assemblies.

C. Sample Warranties: For specified special warranties.

1.6 CLOSEOUT SUBMITTALS

A. Record Documents: For fire-rated door assemblies, list of door numbers and applicable room name and number to which door provides access.

1.7 QUALITY ASSURANCE

A. Fire-Rated Door Inspector Qualifications: Documented as complying with requirements in NFPA 80 .

B. Egress Door Inspector Qualifications: Documented as complying with requirements in NFPA 101 .

1.8 DELIVERY, STORAGE, AND HANDLING

A. Comply with requirements of referenced standard and manufacturer's written instructions.

B. Package doors individually in cardboard cartons, and wrap bundles of doors in plastic sheeting.

C. Mark each door on top and bottom rail with opening number used on Shop Drawings.

1.9 FIELD CONDITIONS

A. Environmental Limitations:

1. Do not deliver or install doors until spaces are enclosed and weathertight, wet-work in spaces is complete and dry, and HVAC system is operating and maintaining temperature and relative humidity at levels designed for building occupants for the remainder of construction period.
2. Do not deliver or install doors until building is enclosed and weathertight, wet work is complete, and HVAC system is operating and maintaining temperature between **60 and 90 deg F** and relative humidity between 25 and 55 percent during remainder of construction period.

1.10 WARRANTY

A. Special Warranty: Manufacturer agrees to repair or replace doors and frames that fail in materials or workmanship within specified warranty period.

1. Failures include, but are not limited to, the following:

a. Delamination of veneer.
b. Warping (bow, cup, or twist) more than **1/4 inch** in a **42-by-84-inch** section.
c. Telegraphing of core construction in face veneers exceeding **0.01 inch in a 3-inch** span.

2. Warranty also includes installation and finishing that may be required due to repair or

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replacement of defective doors and frames.
3. Warranty Period for Solid-Core Exterior Doors: Two years from date of Substantial Completion.
4. Warranty Period for Solid-Core Interior Doors: Life of installation.
5. Warranty Period for Hollow-Core Interior Doors: Two year(s) from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 SOURCE LIMITATIONS

A. Obtain flush wood doors from single manufacturer.

2.2 PERFORMANCE REQUIREMENTS

A. Fire-Rated Door and Frame Assemblies: Assemblies complying with NFPA 80 that are listed and labeled by a qualified testing agency acceptable to authorities having jurisdiction, for fire-protection ratings indicated on Drawings, based on testing at positive pressure in accordance with NFPA 252 or UL 10C.

1. Oversize Fire-Rated Door Assemblies: For units exceeding sizes of tested assemblies, provide certification by a qualified testing agency that doors comply with standard construction requirements for tested and labeled fire-rated door assemblies except for size.

B. Smoke- and Draft-Control Door and Frame Assemblies: Listed and labeled for smoke and draft control based on testing in accordance with UL 1784 by a qualified testing agency acceptable to authorities having jurisdiction.

2.3 FLUSH WOOD DOORS AND FRAMES, GENERAL

A. Quality Standard: In addition to requirements specified, comply with ANSI/WDMA I.S. 1A.

1. Provide labels from certification program indicating that doors and frames comply with requirements of grades specified.
2. The Contract Documents contain requirements that are more stringent than the referenced quality standard. Comply with the Contract Documents in addition to those of the referenced quality standard.

2.4 SOLID-CORE FIVE-PLY FLUSH WOOD VENEER-FACED DOORS AND TRANSOM PANELS FOR TRANSPARENT FINISH

A. Interior Doors, Solid-Core Five-Ply Veneer-Faced:

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. Forte Opening Solutions
   b. Lambton Doors
   c. Lynden Door, Inc.
   d. Manhattan Door Corp.
   e. Oregon Door
   f. Oshkosh Door Company
   g. VT Industries, Inc.

2. Performance Grade: ANSI/WDMA I.S. 1A Extra Heavy Duty.
3. ANSI/WDMA I.S. 1A Quality Grade: Premium.
4. Architectural Woodwork Standards Quality Grade: Premium.
5. Faces: Single-ply wood veneer not less than **1/50 inch** thick.

   a. Species: Select white birch or Select white maple.
   b. Cut: Plain sliced (flat sliced).
   c. Match between Veneer Leaves: Book match.
   d. Assembly of Veneer Leaves on Door Faces: Running match.

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e. Pair and Set Match: Provide for doors hung in same opening or separated only by mullions.
f. Room Match:

1) Match door faces within each separate room or area of building. Corridor-door faces do not need to match where they are separated by 10 ft. or more.
2) Provide door faces of compatible color and grain within each separate room or area of building.

g. Transom Match: Continuous match.
h. Blueprint Match: Where indicated, provide doors with faces produced from same flitches as adjacent wood paneling and arranged to provide blueprint match with wood paneling. Comply with requirements in Section 064216 "Flush Wood Paneling."

6. Exposed Vertical and Top Edges: Same species as faces - Architectural Woodwork Standards edge Type A.

a. Fire-Rated Single Doors: Provide edge construction with intumescent seals concealed by outer stile. Comply with specified requirements for exposed vertical edges.
b. Fire-Rated Pairs of Doors:

1) Provide fire-retardant stiles that are listed and labeled for applications indicated without formed-steel edges and astragals. Provide stiles with concealed intumescent seals. Comply with specified requirements for exposed edges.
2) Provide formed-steel edges and astragals with intumescent seals.

a) Finish steel edges and astragals with baked enamel .
b) Finish steel edges and astragals to match door hardware (locksets or exit devices).

c. Mineral-Core Doors: At hinge stiles, provide laminated-edge construction with improved screw-holding capability and split resistance. Comply with specified requirements for exposed edges.

1) Screw-Holding Capability: 550 lbf in accordance with WDMA T.M. 10.

7. Core for Non-Fire-Rated Doors:

a. Particleboard: ANSI A208.1, Grade LD-2.

1) Blocking: Provide wood blocking in particleboard-core doors as follows:

a) **5-inch** top-rail blocking, in doors indicated to have closers.
b) **5-inch** bottom-rail blocking, in exterior doors and doors indicated to have kick, mop, or armor plates.
c) **5-inch** midrail blocking, in doors indicated to have exit devices.

2) Provide doors with structural-composite-lumber cores instead of particleboard cores for doors scheduled to receive exit devices in Section 087100 "Door Hardware."

b. Structural Composite Lumber:

1) Screw Withdrawal, Door Face: 550 lbf in accordance with WDMA T.M. 10.
2) Screw Withdrawal, Vertical Door Edge: 550 lbf in accordance with WDMA T.M. 10.

8. Core for Fire-Rated Doors: As required to achieve fire-protection rating indicated on Drawings.

a. Blocking for Mineral-Core Doors: Provide composite blocking with improved screw-holding capability approved for use in doors of fire-protection ratings indicated on Drawings as follows:

1) **5-inch** top-rail blocking.
2) **5-inch** bottom-rail blocking, in doors indicated to have protection plates.
3) **5-inch** midrail blocking, in doors indicated to have armor plates.

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4) **4-1/2-by-10-inch** lock blocks, in doors without exit devices.
5) **5-inch** midrail blocking, in doors indicated to have exit devices.

9. Construction: Five plies, hot-pressed bonded (vertical and horizontal edging is bonded to core), with entire unit abrasive planed before veneering.

2.5 LIGHT FRAMES AND LOUVERS

A. Wood Beads for Light Openings in Wood Doors: Provide manufacturer's standard wood beads unless otherwise indicated.

1. Wood Species: Same species as door faces.
2. Profile: Recessed tapered beads.
3. At wood-core doors with 20-minute fire-protection ratings, provide wood beads and metal glazing clips approved for such use.

B. Metal Frames for Light Openings in Fire-Rated Doors: Manufacturer's standard frame formed of **0.048-inch-** thick, cold-rolled steel sheet; with baked-enamel- or powder-coated finish; and approved for use in doors of fire-protection rating indicated on Drawings.

C. Wood Louvers: Door manufacturer's standard solid-wood louvers unless otherwise indicated.

1. Wood Species: Same species as door faces.
2. Profile: Chevron.

2.6 FABRICATION

A. Factory fit doors to suit frame-opening sizes indicated.

1. Comply with clearance requirements of referenced quality standard for fitting unless otherwise indicated.
2. Comply with NFPA 80 requirements for fire-rated doors.

B. Factory machine doors for hardware that is not surface applied.

1. Locate hardware to comply with DHI-TDH-007.
2. Comply with final hardware schedules, door frame Shop Drawings, ANSI/BHMA-156.115-W, and hardware templates.
3. Coordinate with hardware mortises in metal frames, to verify dimensions and alignment before factory machining.
4. For doors scheduled to receive electrified locksets, provide factory-installed raceway and wiring to accommodate specified hardware.
5. Metal Astragals: Factory machine astragals and formed-steel edges for hardware for pairs of fire-rated doors.

C. Transom and Side Panels:

1. Fabricate matching panels with same construction, exposed surfaces, and finish as specified for associated doors.
2. Finish bottom edges of transoms and top edges of rabbeted doors same as door stiles.
3. Fabricate door and transom panels with full-width, solid-lumber , rabbeted, meeting rails.
4. Provide factory-installed spring bolts for concealed attachment into jambs of metal door frames.

D. Openings: Factory cut and trim openings through doors.

1. Light Openings: Trim openings with moldings of material and profile indicated.
2. Glazing: Factory install glazing in doors indicated to be factory finished. Comply with applicable requirements in Section 088000 "Glazing."
3. Louvers: Factory install louvers in prepared openings.

E. Exterior Doors: Factory treat exterior doors with water repellent after fabrication has been completed but before factory finishing.

1. Flash top of outswinging doors with manufacturer's standard metal flashing.

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2.7 FACTORY FINISHING

A. Comply with referenced quality standard for factory finishing.

1. Complete fabrication, including fitting doors for openings and machining for hardware that is not surface applied, before finishing.
2. Finish faces, all four edges, edges of cutouts, and mortises.
3. Stains and fillers may be omitted on bottom edges, edges of cutouts, and mortises.

B. Factory finish doors where indicated in schedules or on Drawings as factory finished.

C. Transparent Finish:

1. Architectural Woodwork Standards Grade: Premium.

   a. System-5, Varnish, Conversion.
   b. System-9, UV Curable, Acrylated Epoxy, Polyester or Urethane.
   c. System-10, UV Curable, Water Based.
   d. System-11, Polyurethane, Catalyzed.

2. ANSI/WDMA I.S. 1A Grade: Premium.

   a. TR-4 Conversion Varnish.
   b. TR-6 Catalyzed Polyurethane.
   c. TR-8 UV Cured Acrylated Polyester/Urethane.

3. Staining: As selected by Architect from manufacturer's full range.
4. Sheen: Satin.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine doors and installed door frames, with Installer present, before hanging doors.

1. Verify that installed frames comply with indicated requirements for type, size, location, and swing characteristics and have been installed with level heads and plumb jambs.
2. Reject doors with defects.

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

3.2 INSTALLATION OF FLUSH WOOD DOORS AND TRANSOM PANELS

A. Hardware: For installation, see Section 087100 "Door Hardware."

B. Install doors and frames to comply with manufacturer's written instructions and referenced quality standard, and as indicated.

C. Install frames level, plumb, true, and straight.

1. Shim as required with concealed shims. Install level and plumb to a tolerance of **1/8 inch in 96 inches**.
2. Anchor frames to anchors or blocking built in or directly attached to substrates.

   a. Secure with countersunk, concealed fasteners and blind nailing.
   b. Use fine finishing nails for exposed fastening, countersunk and filled flush with woodwork.

      1) For factory-finished items, use filler matching finish of items being installed.

3. Fire-Rated Door and Frame Assemblies: Install in accordance with NFPA 80.
4. Smoke- and Draft-Control Door and Frame Assemblies: Install in accordance with NFPA 105.

D. Job-Fitted Doors:

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1. Align and fit doors in frames with uniform clearances and bevels as indicated below.

    a. Do not trim stiles and rails in excess of limits set by manufacturer or permitted for fire-rated doors.

2. Machine doors for hardware.
3. Seal edges of doors, edges of cutouts, and mortises after fitting and machining.
4. Clearances:

    a. Provide **1/8 inch** at heads, jambs, and between pairs of doors.
    b. Provide **1/8 inch** from bottom of door to top of decorative floor finish or covering unless otherwise indicated on Drawings.
    c. Where threshold is shown or scheduled, provide **1/4 inch** from bottom of door to top of threshold unless otherwise indicated.
    d. Comply with NFPA 80 for fire-rated doors.

5. Bevel non-fire-rated doors **1/8 inch in 2 inches** at lock and hinge edges.
6. Bevel fire-rated doors **1/8 inch in 2 inches** at lock edge; trim stiles and rails only to extent permitted by labeling agency.

E. Factory-Fitted Doors: Align in frames for uniform clearance at each edge.

F. Factory-Finished Doors: Restore finish before installation if fitting or machining is required at Project site.

3.3 FIELD QUALITY CONTROL

A. Inspection Agency: Owner will engage a qualified inspector to perform inspections and to furnish reports to Architect.

B. Fire-Rated Door and Frame Acceptance Testing: Test and inspect smoke- and draft-control door and frame assemblies in accordance with NFPA 105.

C. Egress-Door Acceptance Testing: Test and inspect egress doors in accordance with NFPA 101.

D. Repair or remove and replace installations where inspections indicate that they do not comply with specified requirements.

E. Reinspect repaired or replaced installations to determine if replaced or repaired door assembly installations comply with specified requirements.

F. Inspection Report: Prepared and submitted in writing to Architect and Contractor within 24 hours after testing.

3.4 ADJUSTING

A. Operation: Rehang or replace doors that do not swing or operate freely.

B. Factory Finished Doors: Replace doors that are damaged or that do not comply with requirements. Doors may be repaired or refinished if Work complies with requirements and shows no evidence of repair or refinishing.

END OF SECTION 08 14 16

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SECTION 08 31 13 - ACCESS DOORS AND FRAMES

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Flush access doors with exposed flanges.

B. Related Requirements:

1. Section 077200 "Roof Accessories" for roof hatches.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Include construction details, fire ratings, material descriptions, dimensions of individual components and profiles, and finishes.

B. Samples: For each type of access door and frame and for each finish specified, complete assembly minimum **6 by 6 inches** in size.

C. Product Schedule: For access doors and frames.

1.3 CLOSEOUT SUBMITTALS

A. Record Documents: For fire-rated doors, list of applicable room name and number in which access door is located.

1.4 QUALITY ASSURANCE

A. Fire-Rated Door Inspector Qualifications: Inspector for field quality-control inspections of fire-rated door assemblies complies with the qualifications set forth in NFPA 80, Section 5.2.3.1 and the following:

1. Door and Hardware Institute Fire and Egress Door Assembly Inspector (FDAI) certification.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Fire-Rated Access Doors and Frames: Assemblies complying with NFPA 80 that are listed and labeled by a qualified testing agency, for fire-protection ratings indicated, in accordance with NFPA 252 or UL 10B.

2.2 ACCESS DOORS AND FRAMES

A. Flush Access Doors with Exposed Flanges:

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. ACUDOR Products, Inc
b. Babcock-Davis
c. Best Access Doors
d. Cendrex Inc.
e. Elmdor; Morris Group International, Inc.
f. JL Industries; Activar Construction Products Group, Inc.

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g. Karp Associates, Inc
h. Lane-Aire Manufacturing Corp.
i. Larsen's Manufacturing Company
j. Maxam Metal Products Limited
k. Metropolitan Door Industries Corp.
l. MIFAB, Inc
m. Milcor by Duravent; Duravent Group.
n. Nystrom, Inc.
o. Williams Brothers Corporation of America

2. Description: Face of door flush with frame, with exposed flange and concealed hinge.
3. Optional Features: Gasketing.
4. Locations: Wall and ceiling.
5. Door Size: Minimum 8”x8”, size as required for each application.
6. Metallic-Coated Steel Sheet for Door: Nominal 0.064 inch, 16 gage, factory primed.
7. Stainless Steel Sheet for Door: Nominal 0.062 inch, 16 gage, ASTM A480/A480M No. 4 finish.
8. Frame Material: Same material, thickness, and finish as door.
9. Latch and Lock: Cam latch, key operated or Cam latch, hex-head wrench operated.

2.3 MATERIALS

A. Metallic-Coated Steel Sheet: ASTM A653/A653M, Commercial Steel (CS), Type B; with minimum **G60** or **A60** metallic coating.

B. Stainless Steel Plate, Sheet, and Strip: ASTM A240/A240M or ASTM A666, Type 304. Remove tool and die marks and stretch lines, or blend into finish.

C. Stainless Steel Flat Bars: ASTM A666, Type 304. Remove tool and die marks and stretch lines, or blend into finish.

D. Aluminum Extrusions: **ASTM B221**, Alloy 6063.

E. Aluminum Sheet: ASTM B209/B209M, alloy and temper recommended by aluminum producer and finisher for type of use and finish indicated.

F. Frame Anchors: Same material as door face.

G. Inserts, Bolts, and Anchor Fasteners: Hot-dip galvanized steel in accordance with ASTM A153/A153M or ASTM F2329/F2329M.

2.4 FABRICATION

A. General: Provide access door and frame assemblies manufactured as integral units ready for installation.

B. Metal Surfaces: For metal surfaces exposed to view in the completed Work, provide materials with smooth, flat surfaces without blemishes. Do not use materials with exposed pitting, seam marks, roller marks, rolled trade names, or roughness.

C. Doors and Frames: Grind exposed welds smooth and flush with adjacent surfaces. Furnish mounting holes, attachment devices, and fasteners of type required to secure access doors to types of supports indicated.

1. For concealed flanges with drywall bead, provide edge trim for gypsum panels securely attached to perimeter of frames.
2. For concealed flanges with plaster bead for full-bed plaster applications, provide zinc-coated expanded-metal lath and exposed casing bead welded to perimeter of frames.

D. Recessed Access Doors: Form face of panel to provide recess for application of applied finish. Reinforce panel as required to prevent buckling. Provide access sleeves for each latch operator and install in holes cut through finish.

1. For recessed doors with plaster infill, provide self-furring expanded-metal lath attached to door panel.

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E. Latch and Lock Hardware:

1. Quantity: Furnish number of latches and locks required to hold doors tightly closed.
2. Keys: Furnish two keys per lock and key all locks alike.
3. Mortise Cylinder Preparation: Where indicated, prepare door panel to accept cylinder specified in Section 087100 "Door Hardware."

F. Aluminum: After fabrication, apply manufacturer's standard protective coating on aluminum that will come in contact with concrete.

2.5 FINISHES

A. Comply with NAAMM/NOMMA AMP 500 for recommendations for applying and designating finishes.

B. Protect mechanical finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.

C. 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.

D. Painted Finishes: Comply with coating manufacturer's written instructions for cleaning, conversion coating, and applying and baking finish.

1. Factory Primed: Apply manufacturer's standard, lead- and chromate-free, universal primer immediately after surface preparation and pretreatment.

E. Stainless Steel Finishes:

1. Surface Preparation: Remove tool and die marks and stretch lines, or blend into finish.
2. Polished Finish: ASTM A480/A480M No. 4 finish. Grind and polish surfaces to produce uniform finish, free of cross scratches.

   a. Run grain of directional finishes with long dimension of each piece.
   b. When polishing is completed, passivate and rinse surfaces. Remove embedded foreign matter and leave surfaces chemically clean.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.

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

3.2 INSTALLATION OF ACCESS DOORS AND FRAMES

A. Comply with manufacturer's written instructions for installing access doors and frames.

3.3 FIELD QUALITY CONTROL

A. Inspection Agency: Owner will engage a qualified inspector to perform inspections and to furnish reports to Architect.

B. Inspections:

1. Fire-Rated Door Inspections: Inspect each fire-rated access door in accordance with NFPA 80, Section 5.2.

C. Repair or remove and replace installations where inspections indicate that they do not comply with specified requirements.

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D. Reinspect repaired or replaced installations to determine if replaced or repaired door assembly installations comply with specified requirements.

E. Prepare and submit separate inspection report for each fire-rated access door indicating compliance with each item listed in NFPA 80 and.

3.4 ADJUSTING

A. Adjust doors and hardware, after installation, for proper operation.

END OF SECTION 08 31 13

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SECTION 08 33 13 - COILING COUNTER DOORS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Counter door assemblies.

B. Related Requirements:

1. Section 055000 "Metal Fabrications" for door-opening framing and corner guards.
2. Section 099123 "Interior Painting" for finish painting of factory-primed doors.

1.2 ACTION SUBMITTALS

A. Product Data: For each type and size of coiling counter door and accessory.

1. Include construction details, material descriptions, dimensions of individual components, profiles for slats, and finishes.
2. Include rated capacities, operating characteristics, electrical characteristics, and furnished accessories.
3. Include description of automatic closing device and testing and resetting instructions.

B. Shop Drawings: For each installation and for special components not dimensioned or detailed in manufacturer's product data.

1. Include plans, elevations, sections, and mounting details.
2. Include details of equipment assemblies, and indicate dimensions, required clearances, method of field assembly, components, and location and size of each field connection.
3. Include points of attachment and their corresponding static and dynamic loads imposed on structure.
4. Show locations of controls, locking devices , and other accessories.

C. Samples for Initial Selection: Manufacturer's finish charts showing full range of colors and textures available for units with factory-applied finishes.

1. Include similar Samples of accessories involving color selection.

D. Samples for Verification: For each type of exposed finish on the following components, in manufacturer's standard sizes:

1. Curtain slats .
2. Bottom bar .
3. Guides.
4. Brackets.
5. Hood.
6. Laminate-clad counter panel product for each type, color, pattern, and surface finish; laminated to core.
7. Locking device(s).
8. Include similar Samples of accessories involving color selection.

1.3 INFORMATIONAL SUBMITTALS

A. Qualification Data: For Installer.

B. Oversize Construction Certification: For door assemblies required to be fire-rated and that exceed size limitations of labeled assemblies.

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1.4 CLOSEOUT SUBMITTALS

A. Maintenance Data: For coiling counter doors to include in maintenance manuals.

B. Record Documents: For fire-rated doors, list of door numbers and applicable room name and number to which door accesses.

1.5 QUALITY ASSURANCE

A. Installer Qualifications: An entity that employs installers and supervisors who are trained and approved by manufacturer for both installation and maintenance of units required for this Project.

1. Maintenance Proximity: Not more than two hours' normal travel time from Installer's place of business to Project site.

B. Fire-Rated Door Inspector Qualifications: Inspector for field quality control inspections of fire-rated door assemblies is to meet the qualifications set forth in NFPA 80, section 5.2.3.1 and the following:

1. Door and Hardware Institute Fire and Egress Door Assembly Inspector (FDAI) certification.

PART 2 - PRODUCTS

2.1 SOURCE LIMITATIONS

A. Obtain coiling counter doors from single source from single manufacturer.

1. Obtain operators and controls from coiling counter door manufacturer.

2.2 COUNTER DOOR ASSEMBLY

A. Counter Door: Coiling counter door formed with curtain of interlocking metal slats.

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. ACME Rolling Doors
b. Alpine Overhead Doors, Inc
c. Alumatec Pacific Products
d. Amarr; an ASSA ABLOY Group company
e. ASTA America; Janus International Group
f. C.H.I. Overhead Doors, Inc.
g. City Gates USA
h. Clopay Building Products
i. Cookson; a CornellCookson company
j. Cornell; a CornellCookson company
k. Lawrence Doors; by Amarr
l. McKeon Door Company
m. Metro Door LLC
n. Overhead Door Corporation
o. Wayne Dalton; a division of Overhead Door Corporation
p. Woodfold Manufacturing, Inc.

B. Operation Cycles: Door components and operators capable of operating for not less than 20,000. One operation cycle is complete when a door is opened from the closed position to the fully open position and returned to the closed position.

1. Include tamperproof cycle counter.

C. STC Rating: 26.

D. Curtain R-Value: 4.5 deg F x h x sq. ft./Btu.

E. Door Curtain Material: Stainless steel.

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F. Door Curtain Slats: Flat profile slats of 1-1/2-inch center-to-center height.

G. Bottom Bar: Manufacturer's standard continuous channel or tubular shape, fabricated stainless steel and finished to match door.

H. Curtain Jamb Guides: Stainless steel with exposed finish matching curtain slats. Provide continuous integral wear strips to prevent metal-to-metal contact and to minimize operational noise.

I. Hood: Match curtain material and finish.

1. Shape: Round.
2. Mounting: As indicated on Drawings.

J. Integral Frame, Hood, and Fascia: Stainless steel.

1. Mounting: As indicated on Drawings.

K. Sill Configuration: Integral metal sill or coordinate with kitchen equipment.

L. Locking Devices: Equip door with locking device assembly.

1. Locking Device Assembly: Single-jamb side locking bars, operable from inside with thumbturn.

M. Manual Door Operator: Chain-hoist operator.

1. Provide operator with through-wall shaft operation.
2. Provide operator with manufacturer's standard removable operating arm.

N. Curtain Accessories: Equip door with pull-down strap.

O. Door Finish:

1. Stainless Steel Finish: ASTM A480/A480M No. 2B (bright, cold rolled).
2. Interior Curtain-Slat Facing: Match finish of exterior curtain-slat face.

2.3 DOOR CURTAIN MATERIALS AND FABRICATION

A. Door Curtains: Fabricate coiling counter door curtain of interlocking metal slats in a continuous length for width of door without splices. Unless otherwise indicated, provide slats of thickness and mechanical properties recommended by door manufacturer for performance, size, and type of door indicated, and as follows:

1. Stainless Steel Door Curtain Slats: ASTM A240/A240M or ASTM A666, Type 304; sheet thickness of **0.025 inch**; and as required.
2. Insulation: Fill slats for insulated doors with manufacturer's standard thermal insulation complying with maximum flame-spread and smoke-developed indexes of 75 and 450, respectively, according to ASTM E84 or UL 723. Enclose insulation completely within slat faces.
3. Metal Interior Curtain-Slat Facing: Match metal of exterior curtain-slat face.

B. Curtain Jamb Guides: Manufacturer's standard angles or channels and angles of same material and finish as curtain slats unless otherwise indicated, with sufficient depth and strength to retain curtain, to allow curtain to operate smoothly, and to withstand loading. Slot bolt holes for guide adjustment. Provide removable stops on guides to prevent overtravel of curtain.

1. Removable Posts and Jamb Guides: Manufacturer's standard.

2.4 HOODS

A. General: Form sheet metal hood to entirely enclose coiled curtain and operating mechanism at opening head. Contour to fit end brackets to which hood is attached. Roll and reinforce top and bottom edges for stiffness. Form closed ends for surface-mounted hoods and fascia for any portion of between-jamb mounting that projects beyond wall face. Equip hood with intermediate support brackets as required to prevent sagging.

1. Stainless Steel: **0.025-inch-** thick, stainless steel sheet, Type 304, complying with ASTM

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A240/A240M or ASTM A666.

B. Integral Frame, Hood, and Fascia: Welded sheet metal assembly of the following sheet metal(s):

1. Stainless Steel: Type 304, complying with ASTM A240/A240M or ASTM A666.

C. Removable Metal Soffit: Formed or extruded from same metal and with same finish as curtain if hood is mounted above ceiling unless otherwise indicated.

2.5 LOCKING DEVICES

A. Slide Bolt: Fabricate with side-locking bolts to engage through slots in tracks for locking by padlock, located on both left and right jamb sides, operable from coil side.

B. Locking Device Assembly: Fabricate with cylinder lock, spring-loaded dead bolt, operating handle, cam plate, and adjustable locking bars to engage through slots in tracks.

1. Lock Cylinders: As standard with manufacturer and keyed to building keying system.
2. Keys: Three for each cylinder.

C. Chain Lock Keeper: Suitable for padlock.

2.6 CURTAIN ACCESSORIES

A. Astragal: Equip each door bottom bar with a replaceable, adjustable, continuous, compressible gasket of flexible vinyl, rubber, or neoprene as a cushion bumper.

B. Pull-Down Strap: Provide pull-down straps for doors more than **84 inches** high.

2.7 COUNTER DOOR ACCESSORIES

A. Integral Metal Sill: Fabricate sills as integral part of frame assembly of Type 304 stainless steel in manufacturer's standard thickness with ASTM A480/A480M No. 4 finish.

2.8 COUNTERBALANCE MECHANISM

A. General: Counterbalance doors by means of manufacturer's standard mechanism with an adjustable-tension, steel helical torsion spring mounted around a steel shaft and contained in a spring barrel connected to top of curtain with barrel rings. Use grease-sealed bearings or self-lubricating graphite bearings for rotating members.

B. Counterbalance Barrel: Fabricate spring barrel of manufacturer's standard hot-formed, structural-quality, seamless carbon-steel pipe, of sufficient diameter and wall thickness to support rolled-up curtain without distortion of slats and to limit barrel deflection to not more than **0.03 in./ft.** of span under full load.

C. Counterbalance Spring: One or more oil-tempered, heat-treated steel helical torsion springs. Size springs to counterbalance weight of curtain, with uniform adjustment accessible from outside barrel. Secure ends of springs to barrel and shaft with cast-steel barrel plugs.

1. Fire-Rated Doors: Equip with auxiliary counterbalance spring and prevent tension release from main counterbalance spring when automatic closing device operates.

D. Torsion Rod for Counterbalance Shaft: Fabricate of manufacturer's standard cold-rolled steel, sized to hold fixed spring ends and carry torsional load.

E. Brackets: Manufacturer's standard mounting brackets of either cast iron or cold-rolled steel plate.

2.9 MANUAL DOOR OPERATORS

A. General: Equip door with manual door operator by door manufacturer.

B. Push-up Door Operation: Design counterbalance mechanism so that required lift or pull for door

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operation does not exceed 25 lbf.

C. Chain-Hoist Operator: Consisting of endless steel hand chain, chain-pocket wheel and guard, and gear-reduction unit with a maximum 25-lbf force for door operation. Provide alloy-steel hand chain with chain holder secured to operator guide.

D. Crank Operator: Consisting of crank and crank gearbox, steel crank drive shaft, and gear-reduction unit, of type indicated. Size gears to require not more than 25-lbf force to turn crank. Fabricate gearbox to be oiltight and to completely enclose operating mechanism. Provide manufacturer's standard crank-locking device.

2.10 GENERAL FINISH REQUIREMENTS

A. Comply with NAAMM/NOMMA 500 for recommendations for applying and designating finishes.

B. Appearance of Finished Work: Noticeable variations in same piece are not acceptable. Variations in appearance of adjoining components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

2.11 STAINLESS STEEL FINISHES

A. Surface Preparation: Remove tool and die marks and stretch lines, or blend into finish.

B. Polished Finishes: Grind and polish surfaces to produce uniform finish, free of cross scratches.

1. Run grain of directional finishes with long dimension of each piece.
2. When polishing is completed, passivate and rinse surfaces. Remove embedded foreign matter and leave surfaces chemically clean.
3. Directional Satin Finish: ASTM A480/A480M No. 4.

C. Bright, Cold-Rolled, Unpolished Finish: ASTM A480/A480M No. 2B.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates areas and conditions, with Installer present, for compliance with requirements for substrate construction and other conditions affecting performance of the Work.

B. Examine locations of electrical connections.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION, GENERAL

A. Install coiling counter doors and operating equipment complete with necessary hardware, anchors, inserts, hangers, and equipment supports; according to manufacturer's written instructions and as specified.

B. Install coiling counter doors, hoods, controls, and operators at the mounting locations indicated for each door.

3.3 ADJUSTING

A. Adjust hardware and moving parts to function smoothly so that doors operate easily, free of warp, twist, or distortion.

B. Lubricate bearings and sliding parts as recommended by manufacturer.

C. Adjust seals to provide tight fit around entire perimeter.

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3.4 MAINTENANCE SERVICE

A. Initial Maintenance Service: Beginning at Substantial Completion, maintenance service is to include six months' full maintenance by skilled employees of coiling-door Installer. Include monthly preventive maintenance, repair or replacement of worn or defective components, lubrication, cleaning, and adjusting as required for proper door operation. Parts and supplies are to be manufacturer's authorized replacement parts and supplies.

1. Perform maintenance, including emergency callback service, during normal working hours.
2. Include 24-hour-per-day, seven-day-per-week, emergency callback service.

3.5 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain coiling counter doors.

END OF SECTION 08 33 13

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SECTION 08 41 13 - ALUMINUM-FRAMED ENTRANCES AND STOREFRONTS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Aluminum-framed entrance and storefront systems.

1.2 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1.3 ACTION SUBMITTALS

A. Product Data: For each specified system and assembly, including components and accessories.

1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes.
2. Include operating characteristics, electrical characteristics, and furnished accessories.

B. Shop Drawings:

1. Include plans, elevations, sections, full-size details, and attachments to other work.
2. Include details of provisions for assembly expansion and contraction and for draining moisture occurring within the assembly to the exterior.
3. Include full-size isometric details of each type of vertical-to-horizontal intersection of aluminum-framed entrance and storefront systems, showing the following:

   a. Joinery, including concealed welds.
   b. Anchorage.
   c. Expansion provisions.
   d. Glazing.
   e. Flashing and drainage.

4. Include connection to and continuity with adjacent thermal, weather, air, and vapor barriers.
5. Include point-to-point wiring diagrams showing the following:

   a. Power requirements for each electrically operated door hardware.
   b. Location and types of switches, signal device, conduit sizes, and number and size of wires.

6. Signed and sealed by the qualified professional engineer responsible for their preparation.

C. Samples for Initial Selection: Manufacturer's standard color sheets, showing full range of available colors for each type of exposed finish.

D. Samples for Verification: Actual sample of finished products for each type of exposed finish.

1. Size: Manufacturers' standard size.

E. Fabrication Sample: Of each vertical-to-horizontal intersection of assemblies, made from **12-inch** lengths of full-size components and showing details of the following:

1. Joinery, including concealed welds.
2. Anchorage.
3. Expansion provisions.
4. Glazing.
5. Flashing and drainage.

F. Entrance Door Hardware Schedule: Prepared by or under supervision of supplier, detailing fabrication

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and assembly of entrance door hardware, as well as procedures and diagrams. Coordinate final entrance door hardware schedule with doors, frames, and related work to ensure proper size, thickness, hand, function, and finish of entrance door hardware.

G. Delegated Design Submittals: For aluminum-framed entrance and storefront systems, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

1.4 INFORMATIONAL SUBMITTALS

A. Energy Performance Certificates: For aluminum-framed entrance and storefront systems, accessories, and components, from manufacturer.

1. Basis for Certification: NFRC-certified energy performance values for each aluminum-framed entrance and storefront system.

B. Product Test Reports: For aluminum-framed entrance and storefront systems, for tests performed by a qualified testing agency.

C. Preconstruction Test Reports: For aluminum-framed entrance and storefront systems.

1. Testing Program: Developed specifically for Project.
2. Test Reports: Prepared by a qualified preconstruction testing agency for each preconstruction test.
3. Record Drawings: As-built drawings of preconstruction laboratory mockups showing changes made during preconstruction laboratory mockup testing.

D. Source Quality-Control Reports: For aluminum-framed entrance and storefront systems.

E. Field Quality Control Reports: For specified tests and inspections.

F. Quality-Control Program: Developed specifically for Project, including fabrication and installation, in accordance with recommendations in ASTM C1401. Include periodic quality-control reports.

G. Qualification Statements: For Installer .

H. Delegated Design Engineer Qualifications: For aluminum-framed entrance and storefront systems.

I. Sample Warranties: For specified special warranties.

1.5 CLOSEOUT SUBMITTALS

A. Maintenance Contracts: For maintenance service agreement.

B. Operation and Maintenance Data: For aluminum-framed entrance and storefront systems.

C. Maintenance Data for Structural Sealant: For structural-sealant-glazed storefront. Include ASTM C1401 recommendations for post-installation-phase quality-control program.

D. Warranty Documentation: For specified special warranties.

1.6 QUALITY ASSURANCE

A. Installer Qualifications:

1. Fabricator of products.
2. Entity that employs installers and supervisors who are trained and approved by manufacturer.
3. Authorized representative who is trained and approved by manufacturer.
4. Entity that is certified under the North American Contractor Certification Program (NACC) and that employs installers and supervisors who are trained and approved by manufacturer .

B. Delegated Design Engineer Qualifications: A professional engineer who is legally qualified to practice in state where Project is located and who is experienced in providing engineering services of the type indicated.

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C. Product Options: Information on Drawings and in Specifications establishes requirements for aesthetic effects and performance characteristics of assemblies. Aesthetic effects are indicated by dimensions, arrangements, alignment, and profiles of components and assemblies as they relate to sightlines, to one another, and to adjoining construction.

1. Do not change intended aesthetic effects, as judged solely by Architect, except with Architect's written approval. If changes are proposed, submit comprehensive explanatory data to Architect for review.

D. Structural-Sealant Glazing: Comply with ASTM C1401 for design and installation of storefront systems that include structural glazing.

1.7 MOCKUPS

A. Build mockups to set quality standards for materials and execution.

1. Testing to be performed on mockups in accordance with requirements in "Field Quality Control" Article.
2. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Owner specifically approves such deviations by Change Order.
3. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.8 PRECONSTRUCTION TESTING

A. Preconstruction Testing Service: Owner will engage a qualified testing agency to perform preconstruction testing on laboratory mockups.

1. Build preconstruction laboratory mockups at testing agency facility; use personnel, products, and methods of construction that will be used at Project site.
2. Size and Configuration: As indicated on Drawings.
3. Notify Architect seven days in advance of the dates and times when preconstruction laboratory mockups will be tested.

B. Preconstruction Laboratory Mockup Testing: Performed by a qualified testing agency on manufacturer's standard assemblies.

1. Test preconstruction laboratory mockups in accordance with requirements in "Performance Requirements" Article. Perform the following tests in the following order:

a. Structural, 50 Percent Outward-Acting: ASTM E330/E330M at 50 percent of negative test load
b. Structural, 50 Percent Inward-Acting: ASTM E330/E330M at 50 percent of positive test load.
c. Air Leakage: ASTM E283/E283M.
d. Water Penetration under Static Pressure: ASTM E331.
e. Water Penetration under Dynamic Pressure: AAMA 501.1.
f. Structural, 50/100 Percent: ASTM E330/E330M at the following wind loads:

1) 50 percent of positive test load.
2) 100 percent of positive test load.
3) 50 percent of negative test load.
4) 100 percent of negative test load.

g. Repeat the following:

1) Air Leakage: ASTM E283/E283M.
2) Water Penetration under Static Pressure: ASTM E331.
3) Water Penetration under Dynamic Pressure: AAMA 501.1.

h. Thermal Cycling: AAMA 501.5. Repeat the following:

1) Air Leakage: ASTM E283/E283M.
2) Water Penetration under Static Pressure: ASTM E331.

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3) Water Penetration under Dynamic Pressure: AAMA 501.1.

i. Structural, 75/150 Percent: ASTM E330/E330M at the following loads:

1) 75 percent of positive test load.
2) 150 percent of positive test load.
3) 75 percent of negative test load.
4) 150 percent of negative test load.

C. Preconstruction Adhesion and Compatibility Testing: Submit to structural glazing sealant manufacturer, for testing indicated below, Samples of each glazing material type, tape sealant, gasket, glazing accessory, and glass-framing member that is in close proximity to or is touching the structural or nonstructural sealants of a structural glazed system.

1. Compatibility: Test materials or components using ASTM C1087.
2. Adhesion: Test for adhesion or lack of adhesion of a structural sealant to the surface of another material or component using ASTM C1135.
3. Submit no fewer than eight pieces of each type of material, including joint substrates, shims, joint-sealant backings, secondary seals, and miscellaneous materials.
4. Schedule sufficient time for testing and analyzing results to prevent delaying the Work.
5. For materials failing tests, obtain sealant manufacturer's written instructions for corrective measures, including the use of specially formulated primers.
6. Testing will not be required if data based on previous testing of current sealant products match those submitted.

1.9 WARRANTY

A. Special Warranty: Manufacturer agrees to repair or replace components of aluminum-framed entrance and storefront systems that fail in materials or workmanship within specified warranty period.

1. Failures include, but are not limited to, the following:

a. Structural failures .
b. Faulty operation .
c. Deterioration of metals , metal finishes, and other materials beyond normal use.

2. Warranty Period: Five years from date of Substantial Completion.

B. Special Finish Warranty, Factory-Applied Finishes: Standard form in which manufacturer agrees to repair finishes or replace aluminum that shows evidence of deterioration of factory-applied finishes within specified warranty period.

1. Deterioration includes, but is not limited to, the following:

a. Color fading more than 5 Delta E units when tested in accordance with ASTM D2244.
b. Chalking in excess of a No. 8 rating when tested in accordance with ASTM D4214.
c. Cracking, checking, peeling, or failure of paint to adhere to bare metal.

2. Warranty Period: 20 years from date of Substantial Completion.

C. Special Finish Warranty, Anodized Finishes: Standard form in which manufacturer agrees to repair finishes or replace aluminum that shows evidence of deterioration of anodized finishes within specified warranty period.

1. Deterioration includes, but is not limited to, the following:

a. Color fading more than 5 Delta E units when tested in accordance with ASTM D 2244.
b. Chalking in excess of a No. 8 rating when tested in accordance with ASTM D 4214.
c. Cracking, peeling, or chipping.

2. Warranty Period: 10 years from date of Substantial Completion.

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PART 2 - PRODUCTS

2.1 SOURCE LIMITATIONS

A. Obtain all components of aluminum-framed entrance and storefront system, including framing spandrel panels and accessories, from single manufacturer.

2.2 PERFORMANCE REQUIREMENTS

A. Delegated Design: Engage a qualified professional engineer, as defined in Section 014000 "Quality Requirements," to design aluminum-framed entrance and storefront systems.

B. General Performance: Comply with performance requirements specified, as determined by testing of aluminum-framed entrance and storefront systems representing those indicated for this Project without failure due to defective manufacture, fabrication, installation, or other defects in construction.

1. Aluminum-framed entrance and storefront systems to withstand movements of supporting structure, including, but not limited to, twist, column shortening, long-term creep, and deflection from uniformly distributed and concentrated live loads.
2. Failure also includes the following:

   a. Thermal stresses transferring to building structure.
   b. Glass breakage.
   c. Noise or vibration created by wind and thermal and structural movements.
   d. Loosening or weakening of fasteners, attachments, and other components.
   e. Failure of operating units.

C. Seismic Performance: Aluminum-framed entrance and storefront systems to withstand the effects of earthquake motions determined in accordance with ASCE/SEI 7.

1. Seismic Drift Causing Glass Fallout: Complying with criteria for passing based on building occupancy type when tested in accordance with AAMA 501.6 at design displacement and 1.5 times the design displacement.

D. Structural Loads:

1. Wind Loads: As indicated on Drawings.
2. Other Design Loads: As indicated on Drawings.

E. Deflection of Framing Members Supporting Glass: At design wind load, as follows:

1. Deflection Normal to Wall Plane: Limited to 1/175 of length of span of the framing member for lengths of up to 13 ft. 6 inches and to 1/240 of length of span of the framing member plus 1/4 inch for lengths greater than 13 ft. 6 inches.
2. Deflection Parallel to Glazing Plane: Limited to amount not exceeding that which reduces glazing bite to less than 75 percent of design dimension and that which reduces edge clearance between framing members and glazing or other fixed components to less than 1/8 inch.

   a. Operable Units: Provide a minimum **1/16-inch** clearance between framing members and operable units.

F. Structural: Test in accordance with ASTM E330/E330M as follows:

1. When tested at positive and negative wind-load design pressures, storefront assemblies, including entrance doors, do not evidence deflection exceeding specified limits.
2. When tested at 150 percent of positive and negative wind-load design pressures, storefront assemblies, including entrance doors and anchorage, do not evidence material failures, structural distress, or permanent deformation of main framing members exceeding 0.2 percent of span.
3. Test Durations: As required by design wind velocity, but not less than 10 seconds.

G. Thermal Movements: Allow for thermal movements resulting from ambient and surface temperature changes.

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1. Temperature Change: 120 deg F, ambient; 180 deg F, material surfaces.
2. Thermal Cycling: No buckling; stress on glass; sealant failure; excess stress on framing, anchors, and fasteners; or reduction of performance when tested in accordance with AAMA 501.5.

    a. High Exterior Ambient-Air Temperature: That which produces an exterior metal-surface temperature of 180 deg F.
    b. Low Exterior Ambient-Air Temperature: 0 deg F.
    c. Interior Ambient-Air Temperature at High Exterior Ambient-Air Temperature: 75 deg F.
    d. Interior Ambient-Air Temperature at Low Exterior Ambient-Air Temperature: 70 deg F.

H. Water Penetration under Static Pressure: Test in accordance with ASTM E331 as follows:

1. No evidence of water penetration through fixed glazing and framing areas, including entrance doors, when tested in accordance with a minimum static-air-pressure differential of 20 percent of positive wind-load design pressure, but not less than 6.24 lbf/sq. ft..

I. Water Penetration under Dynamic Pressure: Test in accordance with AAMA 501.1 as follows:

1. No evidence of water penetration through fixed glazing and framing areas when tested at dynamic pressure equal to 20 percent of positive wind-load design pressure, but not less than 6.24 lbf/sq. ft..
2. Maximum Water Leakage: No uncontrolled water penetrating assemblies or water appearing on assemblies' normally exposed interior surfaces from sources other than condensation. Water leakage does not include water controlled by flashing and gutters, or water that is drained to exterior.

J. Energy Performance: Certified and labeled by manufacturer for energy performance as follows:

1. Thermal Transmittance (U-factor):

    a. Fixed Glazing and Framing Areas: U-factor for the system of not more than As indicated on drawings as determined in accordance with ANSI/NFRC 100.
    b. Entrance Doors: U-factor of not more than As indicated on drawings as determined in accordance with ANSI/NFRC 100.
    c. Spandrel Panels: Whole spandrel panel U-factor of not more than As indicated on drawings as determined in accordance with ANSI/NFRC 100.

2. Solar Heat-Gain Coefficient (SHGC):

    a. Fixed Glazing and Framing Areas: SHGC for the system of not more than As indicated on drawings as determined in accordance with ANSI/NFRC 200.
    b. Entrance Doors: SHGC of not more than As indicated on drawings as determined in accordance with ANSI/NFRC 200.

3. Air Leakage:

    a. Fixed Glazing and Framing Areas: Air leakage for the system of not more than 0.06 cfm/sq. ft. at a static-air-pressure differential of 6.24 lbf/sq. ft. when tested in accordance with ASTM E283/E283M.
    b. Entrance Doors: Air leakage of not more than 1.0 cfm/sq. ft. at a static-air-pressure differential of **1.57 lbf/sq. ft.** when tested in accordance with ASTM E283/E283M.

4. Condensation Resistance Factor (CRF):

    a. Fixed Glazing and Framing Areas: CRF for the system of not less than 65 as determined in accordance with AAMA 1503.
    b. Entrance Doors: CRF of not less than 65 as determined in accordance with AAMA 1503.

K. Noise Reduction: Test in accordance with ASTM E90, with ratings determined by ASTM E1332, as follows.

1. Outdoor-Indoor Transmission Class: Minimum 30.

L. Structural-Sealant Joints:

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1. Designed to carry gravity loads of glazing.

M. Structural Sealant: ASTM C1184. Capable of withstanding tensile and shear stresses imposed by structural-sealant-glazed, aluminum-framed entrance and storefront systems without failing adhesively or cohesively. When tested for preconstruction adhesion and compatibility, cohesive failure of sealant to occur before adhesive failure.

1. Adhesive failure occurs when sealant pulls away from substrate cleanly, leaving no sealant material behind.
2. Cohesive failure occurs when sealant breaks or tears within itself but does not separate from each substrate, because sealant-to-substrate bond strength exceeds sealant's internal strength.

2.3 ALUMINUM-FRAMED ENTRANCE AND STOREFRONT SYSTEMS

A. Aluminum-Framed Entrance and Storefront System:

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. Arcadia Inc.
   b. CMI Architectural Products, Inc.
   c. CRH Companies
   d. EFCO Corporation; Architectural Metals; Apogee Enterprises, Inc.
   e. Kawneer Company, Inc.; Arconic Corporation
   f. Manko Window Systems, Inc.
   g. OldCastle BuildingEnvelope (OBE)
   h. Trulite Glass & Aluminum Solutions, LLC.
   i. Tubelite Inc.; Architectural Metals; Apogee Enterprises, Inc.

2. Framing Members: Manufacturer's extruded- or formed-aluminum framing members of thickness required and reinforced as required to support imposed loads.

   a. Exterior Framing Construction: Thermally broken.
   b. Interior Vestibule Framing Construction: Nonthermal.
   c. Glazing System: Retained mechanically with gaskets on four sides.
   d. Glazing Plane: Center-set.
   e. Finish: Clear anodic finish.
   f. Fabrication Method: Field-fabricated stick system.
   g. Aluminum: Alloy and temper recommended by manufacturer for type of use and finish indicated.
   h. Steel Reinforcement: As required by manufacturer.

3. Backer Plates: Manufacturer's standard, continuous backer plates for framing members, if not integral, where framing abuts adjacent construction.
4. Brackets and Reinforcements: Manufacturer's standard high-strength aluminum with nonstaining, nonferrous shims for aligning system components.
5. Entrance Doors: Manufacturer's standard glazed entrance doors for manual-swing or power operation.

   a. Door Construction: 1-3/4-inch overall thickness, with minimum 0.125-inch- thick, extruded-aluminum tubular rail and stile members. Mechanically fasten corners with reinforcing brackets that are deeply penetrated and fillet welded or that incorporate concealed tie rods.

      1) Thermal Construction: Thermally broken.

   b. Door Design: Wide stile; 5-inch nominal width.
   c. Glazing Stops and Gaskets: Beveled, snap-on, extruded-aluminum stops and preformed gaskets.

      1) Provide nonremovable glazing stops on outside of door.

   d. Finish: Match adjacent storefront framing finish.

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6. Entrance Door Hardware:

   a. Entrance Door Hardware: Hardware not specified in this Section is specified in Section 087100 "Door Hardware."
   b. General: Provide entrance door hardware and entrance door hardware sets indicated in door and frame schedule for each entrance door, to comply with requirements in this Section.

      1) Entrance Door Hardware Sets: Provide quantity, item, size, finish or color indicated, and products equivalent in function and comparable in quality to named products.
      2) Sequence of Operation: Provide electrified door hardware function, sequence of operation, and interface with other building control systems indicated.
      3) Opening-Force Requirements:

         a) Egress Doors: Not more than **15 lbf** to release the latch and not more than **30 lbf** to set the door in motion and not more than 15 lbf to open the door to its minimum required width.
         b) Accessible Interior Doors: Not more than **5 lbf** to fully open door.

   c. Designations: Requirements for design, grade, function, finish, quantity, size, and other distinctive qualities of each type of entrance door hardware are indicated in "Entrance Door Hardware Sets" Article. Products are identified by using entrance door hardware designations as follows:

      1) Named Manufacturers' Products: Manufacturer and product designation are listed for each door hardware type required for the purpose of establishing minimum requirements. Manufacturers' names are abbreviated in "Entrance Door Hardware Sets" Article.
      2) References to ANSI/BHMA Standards: Provide products complying with these standards and requirements for description, quality, and function.

   d. Pivot Hinges: ANSI/BHMA A156.4, Grade 1.

      1) Offset-Pivot Hinges: Provide top, bottom, and intermediate offset pivots at each door leaf.

   e. Butt Hinges: ANSI/BHMA A156.1, Grade 1, radius corner.

      1) Nonremovable Pins: Provide setscrew in hinge barrel that, when tightened into a groove in hinge pin, prevents removal of pin while entrance door is closed.
      2) Exterior Hinges: Stainless steel, with stainless steel pin.
      3) Quantities:

         a) For doors up to 87 inches high, provide three hinges per leaf.
         b) For doors more than 87 and up to 120 inches high, provide four hinges per leaf.

   f. Continuous-Gear Hinges: ANSI/BHMA A156.26.
   g. Mortise Auxiliary Locks: ANSI/BHMA A156.5, Grade 1.
   h. Manual Flush Bolts: ANSI/BHMA A156.16, Grade 1.
   i. Automatic and Self-Latching Flush Bolts: ANSI/BHMA A156.3, Grade 1.
   j. Panic Exit Devices: ANSI/BHMA A156.3, Grade 1, listed and labeled by a testing and inspecting agency acceptable to authorities having jurisdiction, for panic protection, based on testing in accordance with UL 305.
   k. Cylinders:

      1) As specified in Section 087100 "Door Hardware."
      2) BHMA A156.5, Grade 1.

         a) Keying: Master key system. Permanently inscribe each key with a visual key control number and include notation to be furnished by Owner.

   l. Strikes: Provide strike with black-plastic dust box for each latch or lock bolt; fabricated for aluminum framing.

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m. Operating Trim: ANSI/BHMA A156.6.
n. Removable Mullions: ANSI/BHMA A156.3 extruded aluminum.

1) When used with panic exit devices, provide keyed removable mullions listed and labeled by a testing and inspecting agency acceptable to authorities having jurisdiction, for panic protection, based on testing in accordance with UL 305. Use only mullions that have been tested with exit devices to be used.

o. Closers: ANSI/BHMA A156.4, Grade 1, with accessories required for a complete installation, sized as required by door size, exposure to weather, and anticipated frequency of use; adjustable to comply with field conditions and requirements for opening force.
p. Concealed Overhead Holders and Stops: ANSI/BHMA A156.8, Grade 1.
q. Door Stops: ANSI/BHMA A156.16, Grade 1, floor or wall mounted, as appropriate for door location indicated, with integral rubber bumper.
r. Weather Stripping: Manufacturer's standard replaceable components.

1) Compression Type: Made of ASTM D2000 molded neoprene or ASTM D2287 molded PVC.
2) Sliding Type: AAMA 701/702, made of wool, polypropylene, or nylon woven pile with nylon-fabric or aluminum-strip backing.

s. Weather Sweeps: Manufacturer's standard exterior-door bottom sweep with concealed fasteners on mounting strip.
t. Thresholds: ANSI/BHMA A156.21 raised thresholds beveled with a slope of not more than 1:2, with maximum height of **1/2 inch**.
u. Finger Guards: Manufacturer's standard collapsible neoprene or PVC gasket anchored to frame hinge-jamb at center-pivoted doors.

7. Glazing: Comply with Section 088000 "Glazing."
8. Glazing Gaskets: Manufacturer's standard sealed-corner pressure-glazing system of black, resilient elastomeric glazing gaskets, setting blocks, and shims or spacers.
9. Glazing Sealants: As recommended in writing by manufacturer.

a. Verify architectural sealant has a VOC content of 250 g/L or less.

10. Structural Glazing Sealants: ASTM C1184 chemically curing silicone formulation that is compatible with system components with which it comes in contact; specifically formulated and tested for use as structural sealant and approved by structural-sealant manufacturer for use in storefront system indicated.

a. Color: Black.
b. Verify architectural sealant has a VOC content of 250 g/L or less.

11. Weatherseal Sealants: ASTM C920 for Type S; Grade NS; Class 25; Uses NT, G, A, and O; chemically curing silicone formulation that is compatible with structural sealant and other system components with which it comes in contact; recommended by structural-sealant, weatherseal-sealant, and structural-sealant-glazed storefront manufacturers for this use.

a. Color: Match structural sealant.
b. Verify architectural sealant has a VOC content of 250 g/L or less.

2.4 ACCESSORIES

A. Fasteners and Accessories: Manufacturer's standard corrosion-resistant, nonstaining, nonbleeding fasteners and accessories compatible with adjacent materials.

1. Use self-locking devices where fasteners are subject to loosening or turning out from thermal and structural movements, wind loads, or vibration.
2. Reinforce members as required to receive fastener threads.
3. Use exposed fasteners with countersunk Phillips screw heads , fabricated from 300 series stainless steel.

B. Anchors: Three-way adjustable anchors with minimum adjustment of 1 inch that accommodate

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fabrication and installation tolerances in material and finish compatible with adjoining materials and recommended by manufacturer.

1. Concrete and Masonry Inserts: Hot-dip galvanized cast-iron, malleable-iron, or steel inserts complying with ASTM A123/A123M or ASTM A153/A153M requirements.

C. Concealed Flashing: Manufacturer's standard corrosion-resistant, nonstaining, nonbleeding flashing compatible with adjacent materials.

D. Bituminous Paint: Cold-applied asphalt-mastic paint containing no asbestos, formulated for **30-mil** thickness per coat.

E. Joint Sealants and Backings: Provide joint sealants, backings, and other related materials in accordance with Section 079200 "Joint Sealants."

2.5 MATERIALS

A. Sheet and Plate: ASTM B209/B209M.

B. Extruded Bars, Rods, Profiles, and Tubes: **ASTM B221**.

C. Structural Profiles: ASTM B308/B308M.

D. Steel Reinforcement:

1. Structural Shapes, Plates, and Bars: ASTM A36/A36M.
2. Cold-Rolled Sheet and Strip: ASTM A1008/A1008M.
3. Hot-Rolled Sheet and Strip: ASTM A1011/A1011M.

E. Steel Reinforcement Primer: Manufacturer's standard zinc-rich, corrosion-resistant primer complying with SSPC-PS Guide No. 12.00; applied immediately after surface preparation and pretreatment. Select surface preparation methods in accordance with recommendations in SSPC-SP COM, and prepare surfaces in accordance with applicable SSPC standard.

2.6 FABRICATION

A. Form or extrude aluminum shapes before finishing.

B. Weld in concealed locations to greatest extent possible to minimize distortion or discoloration of finish. Remove weld spatter and welding oxides from exposed surfaces by descaling or grinding.

C. Fabricate components that, when assembled, have the following characteristics:

1. Profiles that are sharp, straight, and free of defects or deformations.
2. Accurately fitted joints with ends coped or mitered.
3. Physical and thermal isolation of glazing from framing members.
4. Accommodations for thermal and mechanical movements of glazing and framing to maintain required glazing edge clearances.
5. Provisions for field replacement of glazing from exterior.
6. Fasteners, anchors, and connection devices that are concealed from view to greatest extent possible.

D. Mechanically Glazed Framing Members: Fabricate for flush glazing without projecting stops.

E. Structural-Sealant-Glazed Framing Members: Include accommodations for using temporary support device to retain glazing in place while structural sealant cures.

F. Storefront Framing: Fabricate components for assembly using shear-block system.

G. Entrance Door Frames: Reinforce as required to support loads imposed by door operation and for installing entrance door hardware.

1. At interior and exterior doors, provide compression weather stripping at fixed stops.

H. Entrance Doors: Reinforce doors as required for installing entrance door hardware.

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1. At pairs of exterior doors, provide sliding-type weather stripping retained in adjustable strip and mortised into door edge.
2. At exterior doors, provide weather sweeps applied to door bottoms.

I. Entrance Door Hardware Installation: Factory install entrance door hardware to the greatest extent possible. Cut, drill, and tap for factory-installed entrance door hardware before applying finishes.

J. After fabrication, clearly mark components to identify their locations in Project in accordance with Shop Drawings.

2.7 ALUMINUM FINISHES

A. Color Anodic Finish: AAMA 611, AA-M12C22A42/A44, Class I, 0.018 mm or thicker.

1. Color: Dark bronze , Black , or As selected by Architect from full range of industry colors and color densities.

2.8 SOURCE QUALITY CONTROL

A. Structural Sealant: Perform quality-control procedures complying with ASTM C1401 recommendations, including, but not limited to, assembly material qualification procedures, sealant testing, and assembly fabrication reviews and checks.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.

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

3.2 INSTALLATION OF ALUMINUM-FRAMED ENTRANCE AND STOREFRONT SYSTEMS

A. General: Install aluminum-framed entrance and storefront systems in accordance with manufacturer's written instructions.

1. Do not install damaged components.
2. Fit frame joints to produce hairline joints free of burrs and distortion. Rigidly secure nonmovement joints. Seal perimeter and other joints watertight unless otherwise indicated.
3. Install components plumb and true in alignment with established lines and grades.

B. Anchorage:

1. Install anchors with separators and isolators to prevent metal corrosion and electrolytic deterioration and to prevent impeding movement of moving joints.
2. Anchor aluminum-framed entrances and storefront systems that have been tested for resistance to structure using anchoring method, fastener type, and fastening frequency identical to that used in testing.

C. Metal Protection:

1. Where aluminum is in contact with dissimilar metals, protect against galvanic action by painting contact surfaces with materials recommended by manufacturer for this purpose or installing nonconductive spacers.
2. Where aluminum is in contact with concrete or masonry, protect against corrosion by painting contact surfaces with bituminous paint.

D. Joint Sealants and Backings: Install in accordance with Section 079200 "Joint Sealants."

1. Set continuous sill members and flashing in full sealant bed.
2. Seal perimeter of framing members with sealant.

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E. Venting Windows: Install venting windows level and plumb, securely anchored, and without distortion. Adjust weather-stripping contact and hardware movement to produce proper operation.

F. Entrance Doors: Install entrance doors to produce smooth operation and tight fit at contact points.

1. Exterior Doors: Install to produce weathertight enclosure and tight fit at weather stripping.
2. Field-Installed Entrance Door Hardware: Install surface-mounted entrance door hardware in accordance with entrance door hardware manufacturers' written instructions using concealed fasteners to greatest extent possible.

G. Glazing: Install glazing as specified in Section 088000 "Glazing."

H. Structural Glazing: Install structural glazing as follows:

1. Prepare surfaces that will contact structural sealant in accordance with sealant manufacturer's written instructions, to ensure compatibility and adhesion. Preparation includes, but is not limited to, cleaning and priming surfaces.
2. Set glazing into framing in accordance with sealant manufacturer and framing manufacturer's written instructions and standard practice. Use a spacer or backer as recommended by manufacturer.
3. Set glazing with proper orientation so that coatings face exterior or interior as specified.
4. Hold glazing in place using temporary retainers of type and spacing recommended in writing by manufacturer, until structural sealant joint has cured.
5. Apply structural sealant to completely fill cavity, in accordance with sealant manufacturer and framing manufacturer's written instructions and in compliance with local codes.
6. Apply structural sealant at temperatures indicated by sealant manufacturer for type of sealant.
7. Allow structural sealant to cure in accordance with manufacturer's written instructions.
8. Clean and protect glass as indicated in Section 088000 "Glazing."
9. After structural sealant has completely cured, remove temporary retainers and insert backer rod between lites of glass as recommended by sealant manufacturer.
10. Install weatherseal sealant to completely fill cavity, in accordance with sealant manufacturer's written instructions, to produce weatherproof joints.

3.3 ERECTION TOLERANCES

A. Install aluminum-framed entrance and storefront systems to comply with the following maximum tolerances:

1. Plumb: **1/8 inch in 10 ft.**; **1/4 inch in 40 ft.**.
2. Level: **1/8 inch in 20 ft.**; **1/4 inch in 40 ft.**.
3. Alignment:

   a. Where surfaces abut in line or are separated by reveal or protruding element up to **1/2 inch** wide, limit offset from true alignment to **1/16 inch**.
   b. Where surfaces are separated by reveal or protruding element from **1/2 to 1 inch** wide, limit offset from true alignment to **1/8 inch**.
   c. Where surfaces are separated by reveal or protruding element of **1 inch** wide or more, limit offset from true alignment to **1/4 inch**.

4. Location: Limit variation from plane to **1/8 inch in 12 ft.**; **1/2 inch** over total length.

3.4 FIELD QUALITY CONTROL

A. Testing Agency: Owner will engage a qualified testing agency to perform tests.

B. Tests: Perform the following tests on representative areas of aluminum-framed entrance and storefront systems.

1. Water-Spray Test: Before installation of interior finishes has begun, areas designated by Architect to be tested in accordance with AAMA 501.2 and to not evidence water penetration.

   a. Perform a minimum of two tests in areas as directed by Architect.
   b. Perform tests in each test area as directed by Architect. Perform at least three tests, prior to 10, 35, and 70 percent completion.

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2. Air Leakage: ASTM E783 at 1.5 times the rate specified for laboratory testing in "Performance Requirements" Article but not more than **0.09 cfm/sq. ft.** at a static-air-pressure differential of **1.57 lbf/sq. ft.**.

    a. Perform a minimum of two tests in areas as directed by Architect.
    b. Perform tests in each test area as directed by Architect. Perform at least three tests, prior to 10, 35, and 70 percent completion.

3. Water Penetration: ASTM E1105 at a minimum uniform static-air-pressure differential of 0.67 times the static-air-pressure differential specified for laboratory testing in "Performance Requirements" Article, but not less than **6.24 lbf/sq. ft.**, and to not evidence water penetration.
4. Structural-Sealant Adhesion: Test structural sealant in accordance with recommendations in ASTM C1401, Destructive Test Method A, "Hand Pull Tab (Destructive)," Appendix X2.

    a. Test a minimum of two areas on each building facade.
    b. Repair installation areas damaged by testing.

C. Inspection Agency: Owner will engage a qualified inspector to perform inspections.

D. Inspections:

1. Egress Door Inspections: Inspect each aluminum-framed entrance door equipped with panic hardware, located in an exit enclosure, electrically controlled, and equipped with special locking arrangements, in accordance with NFPA 101.

E. Aluminum-framed entrance and storefront systems will be considered defective if they do not pass tests and inspections.

F. Prepare test and inspection reports.

3.5 ADJUSTING

A. Adjust hardware and operable components to function smoothly, and lubricate as recommended in writing by manufacturer.

3.6 MAINTENANCE SERVICE

A. Entrance Door Hardware Maintenance:

1. Maintenance Tools and Instructions: Furnish a complete set of specialized tools and maintenance instructions as needed for Owner's continued adjustment, maintenance, and removal and replacement of entrance door hardware.
2. Initial Maintenance Service: Beginning at Substantial Completion, provide six months' full maintenance by skilled employees of entrance door hardware Installer. Include quarterly preventive maintenance, repair or replacement of worn or defective components, lubrication, cleaning, and adjusting as required for proper entrance door hardware operation at rated speed and capacity. Use parts and supplies that are manufacturer's authorized replacement parts and supplies.

3.7 ENTRANCE DOOR HARDWARE SETS

A. Entrance Door Hardware Sets Schedule: See drawings.

END OF SECTION 08 41 13

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SECTION 08 44 13 - GLAZED ALUMINUM CURTAIN WALLS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes: Glazed aluminum curtain wall systems:

1. Conventionally glazed.

B. Related Requirements:

1. Section 014339 "Mockups" for preconstruction laboratory mockup testing.
2. Section 078443 "Joint Firestopping" perimeter fire-containment systems field installed with glazed aluminum curtain walls.
3. Section 079200 "Joint Sealants" for installation of joint sealants installed with glazed aluminum curtain walls and for sealants to the extent not specified in this Section.
4. Section 088000 "Glazing" for curtain wall glazing.

1.2 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of specified product.

1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes.

B. Shop Drawings: For glazed aluminum curtain walls. Include plans, elevations, sections, full-size details, and attachments to other work.

1. Include details of provisions for assembly expansion and contraction and for draining moisture occurring within the assembly to the exterior.
2. Include full-size isometric details of each type of vertical-to-horizontal intersection of glazed aluminum curtain walls, showing the following:

   a. Joinery, including concealed welds.
   b. Anchorage.
   c. Expansion provisions.
   d. Glazing.
   e. Flashing and drainage.

3. Show connection to and continuity with adjacent thermal, weather, air, and vapor barriers.

C. Samples for Initial Selection: For units with factory-applied color finishes.

D. Samples for Verification: For each type of exposed finish required, in manufacturer's standard sizes.

E. Fabrication Sample: Of each vertical-to-horizontal intersection of assemblies, made from **12-inch** lengths of full-size components and showing details of the following:

1. Joinery, including concealed welds.
2. Anchorage.
3. Expansion provisions.
4. Glazing.
5. Flashing and drainage.

F. Delegated Design Submittals: For glazed aluminum curtain walls, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

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1.4 INFORMATIONAL SUBMITTALS

A. Mockup Testing Submittals:

1. Testing Program: Developed specifically for Project.
2. Test Reports: Prepared by a qualified preconstruction testing agency for each mockup test.
3. Record Drawings: As-built drawings of preconstruction laboratory mockups showing changes made during preconstruction laboratory mockup testing.

B. Qualification Data:

1. For Installer .
2. For professional engineer's experience with providing delegated design engineering services of the kind indicated, including documentation that engineer is licensed in the jurisdiction in which Project is located.

C. Energy Performance Certificates: For glazed aluminum curtain walls, accessories, and components from manufacturer.

1. Basis for Certification: NFRC-certified energy performance values for each glazed aluminum curtain wall.

D. Product Test Reports: For glazed aluminum curtain walls, for tests performed by a qualified testing agency.

E. Quality-Control Program: Developed specifically for Project, including fabrication and installation, in accordance with recommendations in ASTM C1401. Include periodic quality-control reports.

F. Source quality control reports.

G. Field quality control reports.

H. Sample Warranties: For special warranties.

1.5 CLOSEOUT SUBMITTALS

A. Maintenance Data: For glazed aluminum curtain walls.

B. Maintenance Data for Structural Sealant: For structural-sealant-glazed curtain walls to include in maintenance manuals. Include ASTM C1401 recommendations for post-installation-phase quality-control program.

1.6 QUALITY ASSURANCE

A. Installer Qualifications: An entity that employs installers and supervisors who are trained and approved by manufacturer and that employs a qualified glazing contractor for this Project who is certified under the North American Contractor Certification Program (NACC) for Architectural Glass & Metal (AGM) contractors and that employs glazing technicians certified under the Architectural Glass and Metal Technician (AGMT) certification program.

B. Laboratory Mockup Testing Agency Qualifications: Qualified in accordance with ASTM E699 for testing indicated and accredited by IAS or ILAC Mutual Recognition Arrangement as complying with ISO/IEC 17025.

C. Testing Agency Qualifications: Qualified in accordance with ASTM E699 for testing indicated and accredited by IAS or ILAC Mutual Recognition Arrangement as complying with ISO/IEC 17025 and acceptable to Owner and Architect.

D. Product Options: Information on Drawings and in Specifications establishes requirements for aesthetic effects and performance characteristics of assemblies. Aesthetic effects are indicated by dimensions, arrangements, alignment, and profiles of components and assemblies as they relate to sightlines, to one another, and to adjoining construction.

1. Do not change intended aesthetic effects, as judged solely by Architect, except with Architect's

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approval. If changes are proposed, submit comprehensive explanatory data to Architect for review.

E. Structural-Sealant Glazing: Comply with ASTM C1401 for design and installation of structural-sealant-glazed curtain wall assemblies.

1.7 MOCKUPS

A. Build mockups to verify selections made under Sample submittals and to demonstrate aesthetic effects and set quality standards for fabrication and installation.

1. Build mockup of typical wall area as indicated on Drawings.
2. Testing shall be performed on mockups in accordance with requirements in "Field Quality Control" Article.
3. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Owner specifically approves such deviations by Change Order.
4. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.8 WARRANTY

A. Special Assembly Warranty: Manufacturer agrees to repair or replace components of glazed aluminum curtain wall that do not comply with requirements or that fail in materials or workmanship 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. Noise or vibration created by wind and thermal and structural movements.
c. Deterioration of metals , metal finishes, and other materials beyond normal weathering.
d. Water penetration through fixed glazing and framing areas.
e. Failure of operating components.

2. Warranty Period: Five years from date of Substantial Completion.

B. Special Finish Warranty, Factory-Applied Finishes: Standard form in which manufacturer agrees to repair finishes or replace aluminum that shows evidence of deterioration of baked enamel, powder coat, or organic finishes within specified warranty period.

1. Deterioration includes, but is not limited to, the following:

a. Color fading more than 5 Delta E units when tested in accordance with ASTM D2244.
b. Chalking in excess of a No. 8 rating when tested in accordance with ASTM D4214.
c. Cracking, checking, peeling, or failure of paint to adhere to bare metal.

2. Warranty Period: Five years from date of Substantial Completion.

C. Special Finish Warranty, Anodized Finishes: Standard form in which manufacturer agrees to repair finishes or replace aluminum that shows evidence of deterioration of anodized finishes within specified warranty period.

1. Deterioration includes, but is not limited to, the following:

a. Color fading more than 5 Delta E units when tested in accordance with ASTM D2244.
b. Chalking in excess of a No. 8 rating when tested in accordance with ASTM D4214.
c. Cracking, peeling, or chipping.

2. Warranty Period: Five years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 SOURCE LIMITATIONS

A. Obtain all components of curtain-wall system and storefront system, including framing and

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accessories, from single manufacturer.

2.2 PERFORMANCE REQUIREMENTS

A. Delegated Design: Engage a qualified professional engineer, as defined in Section 014000 "Quality Requirements," to design glazed aluminum curtain walls.

B. General Performance: Comply with performance requirements specified, as determined by testing of glazed aluminum curtain walls representing those indicated for this Project without failure due to defective manufacture, fabrication, installation, or other defects in construction.

1. Glazed aluminum curtain walls shall withstand movements of supporting structure, including, but not limited to, story drift, twist, column shortening, long-term creep, and deflection from uniformly distributed and concentrated live loads.
2. Failure also includes the following:

a. Thermal stresses transferring to building structure.
b. Glass breakage.
c. Noise or vibration created by wind and thermal and structural movements.
d. Loosening or weakening of fasteners, attachments, and other components.
e. Failure of operating units.

C. Structural Loads:

1. Wind Loads: As indicated on Drawings.
2. Other Design Loads: As indicated on Drawings.

D. Deflection of Framing Members Supporting Glass: At design wind load, as follows:

1. Deflection Normal to Wall Plane: Limited to 1/175 of length of span of the framing member for lengths of up to 13 feet 6 inches and to 1/240 of length of span of the framing member plus 1/4 inch for lengths of greater than 13 feet 6 inches.
2. Deflection Parallel to Glazing Plane: Limited to amount not exceeding that which reduces glazing bite to less than 75 percent of design dimension and that which reduces edge clearance between framing members and glazing or other fixed components to less than 1/8 inch.

a. Operable Units: Provide a minimum **1/16-inch** clearance between framing members and operable units.

3. Cantilever Deflection: Limited to 2/175 of the unsupported length.

E. Structural: Test in accordance with ASTM E330/E330M as follows:

1. When tested at positive and negative wind-load design pressures, assemblies do not evidence deflection exceeding specified limits.
2. When tested at 150 percent of positive and negative wind-load design pressures, assemblies, including anchorage, do not evidence material failures, structural distress, or permanent deformation of main framing members exceeding 0.2 percent of span.
3. Test Durations: As required by design wind velocity, but not less than 60 seconds.

F. Water Penetration under Static Pressure: Test in accordance with ASTM E331 as follows:

1. No evidence of water penetration through fixed glazing and framing areas when tested in accordance with a minimum static-air-pressure differential of 20 percent of positive wind-load design pressure, but not less than 10 lbf/sq. ft..

G. Water Penetration under Dynamic Pressure: Test in accordance with AAMA 501.1 as follows:

1. No evidence of water penetration through fixed glazing and framing areas when tested at dynamic pressure equal to 20 percent of positive wind-load design pressure, but not less than 10 lbf/sq. ft..
2. Maximum Water Leakage: No uncontrolled water penetrating assemblies or water appearing on assemblies' normally exposed interior surfaces from sources other than condensation. Water leakage does not include water controlled by flashing and gutters or water that is drained to exterior.

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H. Interstory Drift: Accommodate design displacement of adjacent stories indicated.

1. Design Displacement: As indicated on Drawings.
2. Test Performance: Complying with criteria for passing based on building occupancy type when tested in accordance with AAMA 501.4 at design displacement and 1.5 times the design displacement.

I. Seismic Performance: Glazed aluminum curtain walls shall withstand the effects of earthquake motions determined in accordance with ASCE/SEI 7.

1. Seismic Drift Causing Glass Fallout: Complying with criteria for passing based on building occupancy type when tested in accordance with AAMA 501.6 at design displacement and 1.5 times the design displacement.
2. Vertical Interstory Movement: Complying with criteria for passing based on building occupancy type when tested in accordance with AAMA 501.7 at design displacement and 1.5 times the design displacement.

J. Energy Performance: Certified and labelled by manufacturer for energy performance as follows:

1. Thermal Transmittance (U-factor):

   a. Fixed Glazing and Framing Areas: U-factor for the system of not more than As indicated on the drawings and COMcheck as determined in accordance with NFRC 100.

2. Solar Heat Gain Coefficient (SHGC):

   a. Fixed Glazing and Framing Areas: SHGC for the system of not more than As indicated on the drawings and COMcheck as determined in accordance with NFRC 200.

3. Air Leakage:

   a. Fixed Glazing and Framing Areas: Air leakage for the system of not more than 0.06 cfm/sq. ft. at a static-air-pressure differential of 6.24 lbf/sq. ft. when tested in accordance with ASTM E283.

4. Condensation Resistance Factor (CRF):

   a. Fixed Glazing and Framing Areas: CRF for the system of not less than 55 as determined in accordance with AAMA 1503.

K. Noise Reduction: Test in accordance with ASTM E90, with ratings determined by ASTM E1332, as follows:

1. Outdoor-Indoor Transmission Class: Minimum 30.
2. Sound Transmission Class: Minimum 34.

L. Windborne-Debris Impact Resistance: Pass ASTM E1886 missile-impact and cyclic-pressure tests in accordance with ASTM E1996 for Wind Zone 2 for enhanced protection.

M. Thermal Movements: Allow for thermal movements resulting from ambient and surface temperature changes:

1. Temperature Change: **120 deg F**, ambient; **180 deg F**, material surfaces.
2. Thermal Cycling: No buckling; stress on glass; sealant failure; excess stress on framing, anchors, and fasteners; or reduction of performance when tested in accordance with AAMA 501.5.

   a. High Exterior Ambient-Air Temperature: That which produces an exterior metal-surface temperature of 180 deg F.
   b. Low Exterior Ambient-Air Temperature: 0 deg F.

N. Structural-Sealant Joints:

1. Designed to carry gravity loads of glazing.

O. Structural Sealant: ASTM C1184. Capable of withstanding tensile and shear stresses imposed by structural-sealant-glazed curtain walls without failing adhesively or cohesively. When tested for

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preconstruction adhesion and compatibility, cohesive failure of sealant shall occur before adhesive failure.

1. Adhesive failure occurs when sealant pulls away from substrate cleanly, leaving no sealant material behind.
2. Cohesive failure occurs when sealant breaks or tears within itself but does not separate from each substrate, because sealant-to-substrate bond strength exceeds sealant's internal strength.

2.3 GLAZED ALUMINUM CURTAIN WALL SYSTEMS

A. Basis-of-Design Product: Subject to compliance with requirements, provide Kawneer 1600 Wall System, outside glazed, pressure plate or comparable product by one of the following:

1. Arcadia Inc.
2. CRH Companies
3. EFCO Corporation; Architectural Metals; Apogee Enterprises, Inc.
4. Kawneer Company, Inc.; Arconic Corporation
5. OldCastle BuildingEnvelope (OBE)
6. TRACO, a division of Kawneer
7. Trulite Glass & Aluminum Solutions, LLC.
8. Tubelite Inc.; Architectural Metals; Apogee Enterprises, Inc.
9. Wausau Window and Wall Systems; Apogee Wausau Group, Inc.

B. Framing Members: Manufacturer's extruded- or formed-aluminum framing members of thickness required and reinforced as required to support imposed loads.

1. Construction: Thermally broken.
2. Glazing System: Retained mechanically with gaskets on four sides.
3. Glazing Plane: Front.
4. Finish: Clear anodic finish or Color anodic finish as indicated in the drawings .
5. System: Stick system.
6. Aluminum: Alloy and temper recommended by manufacturer for type of use and finish indicated.
7. Steel Reinforcement: As required by manufacturer.

C. Pressure Caps: Manufacturer's standard aluminum components that mechanically retain glazing.

1. Include snap-on aluminum trim that conceals fasteners.

D. Brackets and Reinforcements: Manufacturer's standard high-strength aluminum with nonstaining, nonferrous shims for aligning system components.

E. Entrance Door Systems: Comply with Section 084113 "Aluminum-Framed Entrances and Storefronts".

2.4 GLAZING

A. Glazing: Comply with Section 088000 "Glazing."

B. Glazing Gaskets: ASTM C509 or ASTM C864. Manufacturer's standard.

1. Color: Black.

C. Glazing Sealants: Comply with Section 088000 "Glazing."

D. Structural Glazing Sealants: ASTM C1184, chemically curing silicone formulation that is compatible with system components with which it comes into contact, specifically formulated and tested for use as structural sealant and approved by structural-sealant manufacturer for use in curtain-wall assembly indicated.

1. Color: Black.

E. Weatherseal Sealants: ASTM C920 for Type S; Grade NS; Class 25; Uses NT, G, A, and O; chemically curing silicone formulation that is compatible with structural sealant and other system components with which it comes into contact; recommended by structural-sealant, weatherseal-

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sealant, and structural-sealant-glazed curtain-wall manufacturers for this use.

1. Color: Match structural sealant.

2.5 MATERIALS

A. Aluminum Sheet and Plate: **ASTM B209**.

B. Aluminum Extruded Bars, Rods, Profiles, and Tubes: **ASTM B221**.

C. Aluminum Structural Profiles: ASTM B308/B308M.

D. Steel Reinforcement:

1. Structural Shapes, Plates, and Bars: ASTM A36/A36M.
2. Cold-Rolled Sheet and Strip: ASTM A1008/A1008M.
3. Hot-Rolled Sheet and Strip: ASTM A1011/A1011M.

E. Steel Reinforcement Primer: Manufacturer's standard zinc-rich, corrosion-resistant primer complying with SSPC-PS Guide No. 12.00; applied immediately after surface preparation and pretreatment. Select surface preparation methods in accordance with recommendations in SSPC-SP COM, and prepare surfaces in accordance with applicable SSPC standard.

F. Recycled Content: Postconsumer recycled content plus one-half of preconsumer recycled content not less than <**Insert number**> percent.

2.6 ACCESSORIES

A. Fasteners and Accessories: Manufacturer's standard corrosion-resistant, nonstaining, nonbleeding fasteners and accessories compatible with adjacent materials.

1. Use self-locking devices where fasteners are subject to loosening or turning out from thermal and structural movements, wind loads, or vibration.
2. Reinforce members as required to receive fastener threads.
3. Use exposed fasteners with countersunk Phillips screw heads , finished to match framing system.

B. Anchors: Three-way adjustable anchors with minimum adjustment of [**1 inch**]<**Insert dimension**> that accommodate fabrication and installation tolerances in material and finish compatible with adjoining materials and recommended by manufacturer.

1. Concrete and Masonry Inserts: Hot-dip galvanized cast-iron, malleable-iron, or steel inserts complying with ASTM A123/A123M or ASTM A153/A153M requirements.

C. Concealed Flashing: Manufacturer's standard corrosion-resistant, nonstaining, nonbleeding flashing compatible with adjacent materials.

D. Bituminous Paint: Cold-applied asphalt-mastic paint containing no asbestos, formulated for **30-mil** thickness per coat.

2.7 FABRICATION

A. Form or extrude aluminum shapes before finishing.

B. Weld in concealed locations to greatest extent possible to minimize distortion or discoloration of finish. Remove weld spatter and welding oxides from exposed surfaces by descaling or grinding.

C. Fabricate components that, when assembled, have the following characteristics:

1. Profiles that are sharp, straight, and free of defects or deformations.
2. Accurately fitted joints with ends coped or mitered.
3. Physical and thermal isolation of glazing from framing members.
4. Accommodations for thermal and mechanical movements of glazing and framing to maintain required glazing edge clearances.

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5. Provisions for field replacement of glazing from exterior.
6. Fasteners, anchors, and connection devices that are concealed from view to greatest extent possible.
7. Components curved to indicated radii.

D. Fabricate components to resist water penetration as follows:

1. Internal guttering system or other means to drain water passing joints, condensation occurring within framing members, and moisture migrating within glazed aluminum curtain wall to exterior.
2. Pressure-equalized system or double barrier design with primary air and vapor barrier at interior side of glazed aluminum curtain wall and secondary seal weeped and vented to exterior.

E. Curtain-Wall Framing: Fabricate components for assembly using manufacturer's standard assembly method.

F. Factory-Assembled Frame Units:

1. Rigidly secure nonmovement joints.
2. Prepare surfaces that are in contact with structural sealant in accordance with sealant manufacturer's written instructions, to ensure compatibility and adhesion. Preparation includes, but is not limited to, cleaning and priming surfaces.
3. Seal joints watertight unless otherwise indicated.
4. Install glazing to comply with requirements in Section 088000 "Glazing."
5. Install structural glazing.

a. Set glazing into framing in accordance with sealant manufacturer and framing manufacturer's written instructions and standard practice. Use a spacer or backer as recommended by manufacturer.
b. Set glazing with proper orientation so that coatings face exterior or interior as specified.
c. Apply structural silicone sealant to completely fill cavity, in accordance with sealant manufacturers written instructions with the framing and glazing in a fully supported position.
d. Brace or stiffen framing and glazing in such a manner to prevent undue stresses on the glass edge seal and structural joints or movement of the glazing, until sealant is fully cured in accordance with manufacturer's recommendations.
e. After structural sealant has completely cured, insert backer rod between lites of glass as recommended by sealant manufacturer.
f. Install weatherseal sealant to completely fill cavity, in accordance with sealant manufacturer's written instructions, to produce weatherproof joints.
g. Clean and protect glass as indicated in Section 088000 "Glazing."
h. Retain bracing or stiffening until erected to prevent racking of units during transportation and erection.

G. After fabrication, clearly mark components to identify their locations in Project in accordance with Shop Drawings.

H. <**Insert requirements**>.

2.8 ALUMINUM FINISHES

A. Clear Anodic Finish: AAMA 611, AA-M12C22A41, Class I, 0.018 mm or thicker.

B. Color Anodic Finish: AAMA 611, AA-M12C22A42/A44, Class I, 0.018 mm or thicker.

1. Color: As selected by Architect from full range of industry colors and color densities or as indicated on the drawings.

2.9 SOURCE QUALITY CONTROL

A. Structural Sealant: Perform quality-control procedures complying with ASTM C1401 recommendations, including, but not limited to, assembly material qualification procedures, sealant testing, and assembly fabrication reviews and checks.

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PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.

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

3.2 INSTALLATION, GENERAL

A. Comply with manufacturer's written instructions.

B. Do not install damaged components.

C. Fit joints to produce hairline joints free of burrs and distortion.

D. Rigidly secure nonmovement joints.

E. Install anchors with separators and isolators to prevent metal corrosion and electrolytic deterioration and to prevent impeding movement of moving joints.

F. Where welding is required, weld components in concealed locations to minimize distortion or discoloration of finish. Protect glazing surfaces from welding.

G. Seal joints watertight unless otherwise indicated.

H. Metal Protection:

1. Where aluminum is in contact with dissimilar metals, protect against galvanic action by painting contact surfaces with primer, applying sealant or tape, or installing nonconductive spacers as recommended by manufacturer for this purpose.
2. Where aluminum is in contact with concrete or masonry, protect against corrosion by painting contact surfaces with bituminous paint.

I. Install components to drain water passing joints, condensation occurring within framing members, and moisture migrating within glazed aluminum curtain wall to exterior.

J. Install components plumb and true in alignment with established lines and grades.

3.3 INSTALLATION OF GLAZED ALUMINUM CURTAIN WALL SYSTEMS

A. Install operable units level and plumb, securely anchored, and without distortion. Adjust weather-stripping contact and hardware movement to produce proper operation.

3.4 INSTALLATION OF GLAZING

A. Install glazing as specified in Section 088000 "Glazing."

3.5 INSTALLATION OF STRUCTURAL GLAZING

A. Prepare surfaces that will contact structural sealant in accordance with sealant manufacturer's written instructions, to ensure compatibility and adhesion. Preparation includes, but is not limited to, cleaning and priming surfaces.

B. Set glazing into framing in accordance with sealant manufacturer's and framing manufacturer's written instructions and standard practice. Use a spacer or backer as recommended by manufacturer.

C. Set glazing with proper orientation, so that coatings face exterior or interior as specified.

D. Hold glazing in place using temporary retainers of type and spacing recommended by manufacturer, until structural sealant joint has cured.

E. Apply structural sealant to completely fill cavity, in accordance with sealant manufacturer's and framing

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manufacturer's written instructions and in compliance with local codes.

F. Apply structural sealant at temperatures indicated by sealant manufacturer for type of sealant.

G. Allow structural sealant to cure in accordance with manufacturer's recommendations.

H. Clean and protect glass as indicated in Section 088000 "Glazing."

3.6 INSTALLATION OF WEATHERSEAL SEALANT

A. After structural sealant has completely cured, remove temporary retainers and insert backer rod between lites of glass, as recommended by sealant manufacturer.

B. Install weatherseal sealant to completely fill cavity, in accordance with sealant manufacturer's written instructions, to produce weatherproof joints.

3.7 ERECTION TOLERANCES

A. Install glazed aluminum curtain walls to comply with the following maximum tolerances:

1. Plumb: **1/8 inch in 10 feet**; **1/4 inch in 40 feet**.
2. Level: **1/8 inch in 20 feet**; **1/4 inch in 40 feet**.
3. Alignment:

   a. Where surfaces abut in line or are separated by reveal or protruding element up to **1/2 inch** wide, limit offset from true alignment to **1/16 inch**.
   b. Where surfaces are separated by reveal or protruding element from **1/2 to 1 inch** wide, limit offset from true alignment to **1/8 inch**.
   c. Where surfaces are separated by reveal or protruding element of **1 inch** wide or more, limit offset from true alignment to **1/4 inch**.

4. Location: Limit variation from plane to **1/8 inch in 12 feet**; **1/2 inch** over total length.

3.8 FIELD QUALITY CONTROL

A. Testing Agency: Engage a qualified testing agency to perform tests and inspections.

B. Test Area: Perform tests on representative areas of glazed aluminum curtain walls.

C. Field Quality-Control Testing: Perform the following test on representative areas of glazed aluminum curtain walls.

1. Water-Spray Test: Before installation of interior finishes has begun, areas designated by Architect shall be tested in accordance with AAMA 501.2 and shall not evidence water penetration.

   a. Perform a minimum of two tests in areas as directed by Architect.
   b. Perform tests in each test area as directed by Architect. Perform at least three tests, prior to 10, 35, and 70 percent completion.

2. Air Leakage: ASTM E783 at 1.5 times the rate specified for laboratory testing in "Performance Requirements" Article but not more than **0.09 cfm/sq. ft.** at a static-air-pressure differential of **1.57 lbf/sq. ft.**.

   a. Perform a minimum of two tests in areas as directed by Architect.
   b. Perform tests in each test area as directed by Architect. Perform at least three tests, prior to 10, 35, and 70 percent completion.

3. Water Penetration: ASTM E1105 at a minimum uniform static-air-pressure differential of 0.67 times the static-air-pressure differential specified for laboratory testing in "Performance Requirements" Article, but not less than **6.24 lbf/sq. ft.**, and shall not evidence water penetration.

D. Structural-Sealant Adhesion: Test structural sealant in accordance with recommendations in ASTM

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C1401, Destructive Test Method A, "Hand Pull Tab (Destructive)," Appendix X2.

1. Test a minimum of two areas on each building facade.
2. Repair installation areas damaged by testing.

E. Glazed aluminum curtain walls will be considered defective if they do not pass tests and inspections.

F. Prepare test and inspection reports.

END OF SECTION 08 44 13

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SECTION 08 53 13 - VINYL WINDOWS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Vinyl windows.

1.2 DEFINITIONS

A. Combination Assemblies: An assembly formed by a combination of two or more separate fenestration products whose frames are mulled together utilizing a combination mullion or reinforcing mullion.

B. Combination Mullions: A horizontal or vertical member formed by joining two or more individual fenestration units together without a mullion stiffener.

C. Reinforcing Mullions: A horizontal or vertical member with an added continuous mullion stiffener and joining two or more individual fenestration units along the sides of the mullion stiffener.

1.3 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1. Review and finalize construction schedule and verify availability of materials, Installer's personnel, equipment, and facilities needed to make progress and avoid delays.
2. Review, discuss, and coordinate interrelationship of vinyl windows with other exterior wall components. Include provisions for anchoring, flashing, weeping, sealing perimeters, and protecting finishes.
3. Review and discuss sequence of work required to construct a watertight and weathertight exterior building envelope.
4. Inspect and discuss condition of substrate and other preparatory work performed by other trades.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of specified product.

1. Include construction details, material descriptions, glazing and fabrication methods, dimensions of individual components and profiles, hardware, and finishes.

B. Shop Drawings:

1. Plans, elevations, sections, hardware, accessories, insect screens, operational clearances, and details of installation, including anchor, flashing, and sealant installation.

C. Samples for Initial Selection: Manufacturer's standard color sheets, showing full range of available colors for each type of exposed finish.

D. Samples for Verification: Actual sample of finished products for each type of exposed finish:

1. Exposed Finishes: 2 by 4 inches.
2. Exposed Hardware: Full-size units.

E. Product Schedule: For vinyl windows. Use same designations indicated on Drawings.

F. Delegated Design Submittals: For reinforcing mullions, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

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1.5 INFORMATIONAL SUBMITTALS

A. Product Test Reports: For each type of vinyl window, for tests performed by a qualified testing agency.

B. Field Quality Control Reports: For vinyl windows.

C. Qualification Statements: For manufacturer and Installer.

D. Delegated Design Engineer Qualifications: For reinforcing mullions.

E. Sample warranties.

1.6 CLOSEOUT SUBMITTALS

A. Warranty Documentation:

1. Manufacturers' special warranties.

1.7 QUALITY ASSURANCE

A. Manufacturer Qualifications: A manufacturer capable of fabricating vinyl windows that meet or exceed performance requirements indicated and of documenting this performance by test reports and calculations.

B. Installer Qualifications: Authorized representative who is trained and approved by vinyl window manufacturer.

C. Delegated Design Engineer Qualifications: A professional engineer who is legally qualified to practice in state where Project is located and who is experienced in providing engineering services of the type indicated.

D. Testing Agency Qualifications: An FGIA-accredited testing agency for testing indicated.

1.8 MOCKUPS

A. Build mockups to verify selections made under Sample submittals, to demonstrate aesthetic effects, and to set quality standards for materials and execution.

1. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Owner specifically approves such deviations by Change Order.
2. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.9 WARRANTY

A. Special Warranty: Manufacturer agrees to repair or replace vinyl windows that fail in materials or workmanship within specified warranty period.

1. Failures include, but are not limited to, the following:

   a. Failure to meet performance requirements.
   b. Structural failures including excessive deflection, water leakage, and air infiltration.
   c. Faulty operation of movable sash and hardware.
   d. Deterioration of materials and finishes beyond normal weathering.
   e. Failure of insulating glass.

2. Warranty Period:

   a. Window: Five years from date of Substantial Completion.
   b. Glazing Units: 10 years from date of Substantial Completion.

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PART 2 - PRODUCTS

2.1 SOURCE LIMITATIONS

A. Obtain vinyl windows from single source from single manufacturer.

2.2 PERFORMANCE REQUIREMENTS

A. Delegated Design: Engage a qualified professional engineer, as defined in Section 014000 "Quality Requirements," to design reinforcing mullions.

B. Product Standard: Comply with AAMA/WDMA/CSA 101/I.S.2/A440 for definitions and minimum standards of performance, materials, components, accessories, and fabrication unless more stringent requirements are indicated.

1. Window Certification: FGIA or WDMA certified with label attached to each window.

C. Performance Class and Grade: AAMA/WDMA/CSA 101/I.S.2/A440 as follows:

1. Minimum Performance Class: LC.
2. Minimum Performance Grade: 25.
3. Mulled Window Systems: Evaluate and rate combination assemblies as single systems as determined by AAMA 450 in accordance with AAMA/WDMA/CSA 101/I.S.2/A440 requirements.

D. Energy Performance: Certified and labeled by manufacturer for energy performance as follows:

1. Thermal Transmittance (U-factor): As determined in accordance with NFRC 100:

   a. Fixed Windows: Not more than As indicated on drawings.
   b. Operable Windows: Not more than As indicated on drawings.

2. Solar Heat-Gain Coefficient (SHGC): As determined in accordance with NFRC 200.

   a. Fixed Windows: Not more than As indicated on drawings.
   b. Operable Windows: Not more than As indicated on drawings as determined in accordance with NFRC 200.

E. Outdoor-Indoor Transmission Class (OITC): Rated for not less than 26 OITC when tested for laboratory sound transmission loss in accordance with ASTM E90 and determined by ASTM E1332.

2.3 VINYL WINDOWS

A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1. All Seasons Architectural Windows Mfg., Inc.; All Seasons Commercial Division, Inc.
2. Cornerstone Bldg Brands (Ply-Gem)
3. Gerkin Windows & Doors
4. Intus Windows
5. JELD-WEN, Inc.
6. MI Windows and Doors, LLC
7. Milgard Manufacturing, LLC
8. Pella Corporation
9. PGT Custom Windows + Doors; PGT Innovations (PGTI)
10. Quaker Windows Products Co.
11. Shwinco Architectural Products LLC
12. Simonton Windows, Inc.
13. Thermal Windows, Inc.
14. Thermo-Tech Windows and Doors LLC.
15. VPI Quality Windows, Inc.; JELD-WEN Holding, Inc.

B. Provide manufacturer's standard vinyl window assemblies consisting of frames, sashes, glass, hardware, fasteners, and all components and accessories as required for a complete installation.

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C. Operating Types: Provide the following operating types in locations indicated on Drawings:

1. Casement: Project out.
2. Awning: Project out.
3. Single hung.
4. Double hung.
5. Horizontal sliding.
6. Fixed.

D. Frames and Sashes: Impact-resistant, UV-stabilized PVC complying with AAMA/WDMA/CSA 101/I.S.2/A440.

1. Finish: Integral color, As indicated on drawings or as selected by Architect from Manufacturer's full range.
2. Gypsum Board Returns: Provide at interior face of frame.

E. Glass: Clear annealed glass, ASTM C1036, Type 1, Class 1, q3.

1. Kind: Fully tempered where indicated on Drawings.

F. Insulating-Glass Units: ASTM E2190.

1. Glass: ASTM C1036, Type 1, Class 1, q3.

a. Tint: As indicated on drawings.
b. Kind: Fully tempered where indicated on Drawings.

2. Lites: Two.
3. Filling: Fill space between glass lites with argon.
4. Low-E Coating: Pyrolytic on second surface.

G. Glazing System: Manufacturer's standard factory-glazing system that produces weathertight seal.

H. Hardware, General: Provide manufacturer's standard hardware fabricated from aluminum, stainless steel, carbon steel complying with AAMA 907, or other corrosion-resistant material compatible with adjacent materials; designed to smoothly operate, tightly close, and securely lock windows, and sized to accommodate sash weight and dimensions.

1. Exposed Hardware Color and Finish: As selected by Architect from manufacturer's full range.

I. Weather Stripping: Provide full-perimeter weather stripping for each operable sash unless otherwise indicated.

J. Fasteners: Noncorrosive and compatible with window members, trim, hardware, anchors, and other components.

1. Exposed Fasteners: Avoid exposed fasteners to greatest extent possible. For application of hardware, use fasteners that match finish hardware being fastened.

K. Mullions: Provide combination and reinforcing mullions and cover plates matching window units, complete with anchors for support to structure. Allow for erection tolerances and provide for movement of window units due to thermal expansion and building deflections. Provide reinforcing mullions and cover plates capable of withstanding design wind loads of window units.

2.4 ACCESSORIES

A. Dividers (False Muntins): Provide divider grilles in designs indicated for each sash lite.

1. Quantity and Type: As indicated on drawings.
2. Material: Manufacturer's standard.
3. Pattern: As indicated on Drawings.
4. Profile: As selected by Architect from manufacturer's full range.
5. Color: As selected by Architect from manufacturer's full range.

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2.5 FABRICATION

A. Fabricate vinyl windows in sizes indicated. Include a complete system for installing and anchoring windows.

B. Glaze vinyl windows in the factory.

C. Weather strip each operable sash to provide weathertight installation.

D. Hardware: Mount hardware through double walls of vinyl extrusions or provide corrosion-resistant reinforcement.

E. Window Assemblies: Bow. Provide window units in configuration indicated on Drawings. Provide window frames, sashes, hardware, and other trim and components necessary for a complete, secure, and weathertight installation, including the following:

1. Combination and reinforcing mullions with interior and exterior trim.
2. Interior and exterior extension and trim.
3. Top and bottom plywood platforms.
4. Support brackets.

F. Complete fabrication, assembly, finishing, hardware application, and other work in the factory to greatest extent possible. Disassemble components only as necessary for shipment and installation. Allow for scribing, trimming, and fitting at Project site.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine openings, substrates, structural support, anchorage, and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.

B. Verify rough opening dimensions, levelness of sill plate, and operational clearances.

C. Examine wall flashings, vapor retarders, air and weather barriers, and other built-in components to ensure weathertight window installation.

D. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Comply with manufacturer's written instructions for installing windows, hardware, accessories, and other components. For installation procedures and requirements not addressed in manufacturer's written instructions, comply with installation requirements in ASTM E2112.

B. Install windows level, plumb, square, true to line, without distortion, anchored securely in place to structural support, and in proper relation to wall flashing and other adjacent construction to produce weathertight construction.

C. Mullions: Install combination and reinforcing mullions for combination assemblies in accordance with manufacturer's written instructions.

3.3 FIELD QUALITY CONTROL

A. Testing Agency: Owner will engage a qualified testing agency to perform tests and inspections.

1. Testing and inspecting agency will interpret tests and state in each report whether tested work complies with or deviates from requirements.

B. Testing Services: Testing and inspecting of installed windows to take place as follows:

1. Testing Methodology: Testing of windows for air infiltration and water resistance will be performed in accordance with AAMA 502.

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2. Air-Infiltration Testing:

   a. Test Pressure: That required to determine compliance with AAMA/WDMA/CSA 101/I.S.2/A440 performance class indicated.
   b. Allowable Air-Leakage Rate: 1.5 times the applicable AAMA/WDMA/CSA 101/I.S.2/A440 rate for product type and performance class rounded down to one decimal place.

3. Water-Resistance Testing:

   a. Test Pressure: Two-thirds times test pressure required to determine compliance with AAMA/WDMA/CSA 101/I.S.2/A440 performance grade indicated.
   b. Allowable Water Infiltration: No water penetration.

4. Testing Extent: One window(s) of each type as selected by Architect and a qualified independent testing and inspecting agency. Windows will be tested at 5, 50, and 90 percent completion.
5. Test Reports: Prepared in accordance with AAMA 502.

C. Test and Inspections:

   1. Windows will be considered defective if they do not pass tests and inspections.

D. Prepare test and inspection reports.

3.4 ADJUSTING

A. Adjust operating sashes and hardware for a tight fit at contact points and weather stripping for smooth operation and weathertight closure.

3.5 CLEANING

A. Clean exposed surfaces immediately after installing windows using manufacturer's written instructions. Remove excess sealants, glazing materials, dirt, and other substances.

B. Remove and replace sashes if glass has been broken, chipped, cracked, abraded, or damaged during construction period.

3.6 PROTECTION

A. Protect window surfaces from contact with contaminating substances resulting from construction operations. If contaminating substances do contact window surfaces, remove contaminants immediately in accordance with manufacturer's written instructions.

END OF SECTION 08 53 13

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SECTION 08 80 00 - GLAZING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Monolithic glass.
2. Laminated glass.
3. Insulating glass units.
4. Glazing sealants.
5. Glazing tapes.
6. Miscellaneous glazing materials.

B. Related Requirements:

1. Section 057313 "Glazed Decorative Metal Railings" for glazing in railings.

1.2 DEFINITIONS

A. Glass Manufacturers: Firms that produce primary glass, fabricated glass, or both, as defined in referenced glazing publications.

B. Glass Thicknesses: Indicated by thickness designations in millimeters in accordance with ASTM C1036.

C. IBC: International Building Code.

D. Interspace: Space between lites of an insulating-glass unit.

1.3 COORDINATION

A. Coordinate glazing channel dimensions to provide necessary bite on glass, minimum edge and face clearances, and adequate sealant thicknesses, with reasonable tolerances to achieve proper safety margins for glazing retention under each design load case, load case combination, and service condition.

1.4 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1. Review and finalize construction schedule and verify availability of materials, Installer's personnel, equipment, and facilities needed to make progress and avoid delays.
2. Review temporary protection requirements for glazing during and after installation.

1.5 ACTION SUBMITTALS

A. Product Data: For each type of specified product.

B. Glass Samples: For each type of glass product other than clear monolithic vision glass; **12 inches** square.

1. Bird-friendly glass.

C. Glazing Accessory Samples: For sealants, in **12-inch** lengths. Install sealant Samples between two strips of material representative in color of adjoining framing system.

D. Glazing Schedule: List glass types and thicknesses for each size opening and location. Use same designations indicated on Drawings.

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E. Delegated Design Submittals: For glass indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by qualified professional engineer responsible for their preparation.

1.6 INFORMATIONAL SUBMITTALS

A. Product Certificates: For glass.

B. Product Test Reports: For fabricated glass and glazing sealants, for tests performed by a qualified testing agency.

1. For glazing sealants, provide test reports based on testing current sealant formulations within previous 36-month period.

C. Preconstruction adhesion and compatibility test report.

D. Sample Warranties: For special warranties.

1.7 QUALITY ASSURANCE

A. Fabricated-Glass Manufacturer Qualifications: A qualified manufacturer of fabricated glass units who is approved by primary glass manufacturer.

B. Installer Qualifications: A qualified glazing contractor for this Project who is certified under the North American Contractor Certification Program (NACC) for Architectural Glass & Metal (AG&M) contractors .

C. Glass Testing Agency Qualifications: A qualified independent testing agency accredited according to the NFRC CAP 1 Certification Agency Program.

D. Sealant Testing Agency Qualifications: An independent testing agency qualified according to ASTM C1021 to conduct the testing indicated.

1.8 MOCKUPS

A. Build mockups to demonstrate aesthetic effects and to set quality standards for materials and execution.

1. Install glazing in mockups specified in Section 084113 "Aluminum-Framed Entrances and Storefronts" to match glazing systems required for Project, including glazing methods.
2. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Owner specifically approves such deviations by Change Order.
3. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.9 PRECONSTRUCTION TESTING

A. Preconstruction Adhesion and Compatibility Testing: Test each glass product, tape sealant, gasket, glazing accessory, and glass-framing member for adhesion to and compatibility with elastomeric glazing sealants.

1. Testing is not required if data are submitted based on previous testing of current sealant products and glazing materials matching those submitted.
2. Use ASTM C1087 to determine whether priming and other specific joint-preparation techniques are required to obtain rapid, optimum adhesion of glazing sealants to glass, tape sealants, gaskets, and glazing channel substrates.
3. Test no fewer than eight Samples of each type of material, including joint substrates, shims, sealant backings, secondary seals, and miscellaneous materials.
4. Schedule enough time for testing and analyzing results to prevent delaying the Work.
5. For materials failing tests, submit sealant manufacturer's written instructions for corrective measures including use of specially formulated primers.

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1.10 DELIVERY, STORAGE, AND HANDLING

A. Protect glazing materials in accordance with manufacturer's written instructions. Prevent damage to glass and glazing materials from condensation, temperature changes, direct exposure to sun, or other causes.

B. Comply with insulating-glass manufacturer's written instructions for venting and sealing units to avoid hermetic seal ruptures due to altitude change.

1.11 FIELD 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 glazing sealants when ambient and substrate temperature conditions are outside limits permitted by sealant manufacturer or are below **40 deg F**.

1.12 WARRANTY

A. Manufacturer's Special Warranty for Coated-Glass Products: Manufacturer agrees to replace coated-glass units that deteriorate within specified warranty period. Deterioration of coated glass is defined as defects developed from normal use that are not attributed to glass breakage or to maintaining and cleaning coated glass contrary to manufacturer's written instructions. Defects include peeling, cracking, and other indications of deterioration in coating.

1. Warranty Period: 10 years from date of Substantial Completion.

B. Manufacturer's Special Warranty for Laminated Glass: Manufacturer agrees to replace laminated-glass units that deteriorate within specified warranty period. Deterioration of laminated glass is defined as defects developed from normal use that are not attributed to glass breakage or to maintaining and cleaning laminated glass contrary to manufacturer's written instructions. Defects include edge separation, delamination materially obstructing vision through glass, and blemishes exceeding those allowed by referenced laminated-glass standard.

1. Warranty Period: 10 years from date of Substantial Completion.

C. Manufacturer's Special Warranty for Insulating Glass: Manufacturer agrees to replace insulating-glass units that deteriorate within specified warranty period. Deterioration of insulating glass is defined as failure of hermetic seal under normal use that is not attributed to glass breakage or to maintaining and cleaning insulating glass contrary to manufacturer's written instructions. Evidence of failure is obstruction of vision by dust, moisture, or film on interior surfaces of glass.

1. Warranty Period: 10 years from date of Substantial Completion.

D. Manufacturer's Special Warranty for Heat-Soaked Tempered Glass: Manufacturer agrees to replace heat-soaked tempered glass units that spontaneously break due to nickel sulfide (NiS) inclusions at a rate exceeding 0.3 percent (3/1000) within specified warranty period. Coverage for any other cause is excluded.

1. Warranty Period: 10 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 SOURCE LIMITATIONS

A. Source Limitations for Glass: Obtain glass from single source from single manufacturer.

B. Source Limitations for Glazing Accessories: For each product and installation method, obtain from single source from single manufacturer.

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2.2 PERFORMANCE REQUIREMENTS

A. General: Installed glazing systems to withstand normal thermal movement and wind and impact loads (where applicable) without failure, including loss or glass breakage attributable to defective manufacture, fabrication, or installation; failure of sealants or gaskets to remain watertight and airtight; deterioration of glazing materials; or other defects in construction.

B. Delegated Design: Engage a qualified professional engineer, as defined in Section 014000 "Quality Requirements," to design glazing.

C. Structural Performance: Glazing to withstand the following design loads within limits and under conditions indicated determined in accordance with the IBC and ASTM E1300:

1. Design Wind Pressures: As indicated on Drawings.

    a. Wind Design Data: As indicated on Drawings.
    b. Basic Wind Speed: 100 mph.
    c. Importance Factor: 1.0.
    d. Exposure Category: C.

2. Design Snow Loads: As indicated on Drawings.
3. Probability of Breakage for Sloped Glazing: For glass sloped more than 15 degrees from vertical, design glass for a probability of breakage not greater than 0.001.
4. Maximum Lateral Deflection: For glass supported on all four edges, limit center-of-glass deflection at design wind pressure to not more than 1/50 times the short-side length or **1 inch**, whichever is less.
5. Thermal Loads: Design glazing to resist thermal stress breakage induced by differential temperature conditions and limited air circulation within individual glass lites and insulated glazing units.

D. Safety Glazing: Where safety glazing is indicated, provide glazing that complies with 16 CFR 1201, Category II.

E. Thermal and Optical Performance Properties: Provide glass with performance properties specified, as indicated in manufacturer's published test data, based on procedures indicated below:

1. For monolithic-glass lites, properties are based on units with lites 6 mm thick.
2. For laminated-glass lites, properties are based on products of construction indicated.
3. For insulating-glass units, properties are based on units of thickness indicated for overall unit and for each lite.
4. U-Factors: Center-of-glazing values, in accordance with NFRC 100 and based on most current non-beta version of LBL's WINDOW computer program, expressed as **Btu/sq. ft. x h x deg F**.
5. SHGC and Visible Transmittance: Center-of-glazing values, in accordance with NFRC 200 and based on most current non-beta version of LBL's WINDOW computer program.
6. Visible Reflectance: Center-of-glazing values, in accordance with NFRC 300.

2.3 GLASS, GENERAL

A. Glazing Publications: Comply with written instructions of glass product manufacturers and organizations below unless more stringent requirements are indicated. See these publications for glazing terms not otherwise defined in this Section or in referenced standards.

1. NGA Publications: "Laminated Glazing Reference Manual" and "Glazing Manual."
2. AAMA Publications: AAMA GDSG-1 and AAMA TIR A7.
3. IGMA Publication for Sloped Glazing: IGMA TB-3001.
4. IGMA Publication for Insulating Glass: IGMA TM-3000.

B. Safety Glazing Labeling: Where safety glazing is indicated, permanently mark glazing with certification label of the SGCC or another certification agency acceptable to authorities having jurisdiction. Label indicates manufacturer's name, type of glass, thickness, and safety glazing standard with which glass complies.

C. Thickness: Where glass thickness is indicated, it is a minimum. Provide glass that complies with performance requirements and is not less than thickness indicated.

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1. Minimum Glass Thickness for Exterior Lites: 6 mm.
2. Thickness of Tinted Glass: Provide same thickness for each tint color indicated throughout Project.

D. Strength: Where annealed float glass is indicated, provide annealed float glass, heat-strengthened float glass, or fully tempered float glass as needed to comply with "Performance Requirements" Article. Where heat-strengthened float glass is indicated, provide heat-strengthened float glass or fully tempered float glass as needed to comply with "Performance Requirements" Article. Where fully tempered float glass is indicated, provide fully tempered float glass.

2.4 MONOLITHIC GLASS

A. Clear Annealed Float Glass: ASTM C1036, Type I, Class 1 (clear), Quality-Q3.

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. AGC Glass Company North America, Inc.
   b. Cardinal Glass Industries, Inc.
   c. Guardian Glass LLC
   d. Pilkington North America; NSG Group
   e. Vitro Architectural Glass

B. Fully Tempered Float Glass : ASTM C1048, Kind FT (fully tempered), Condition A (uncoated) unless otherwise indicated, Type I, Class 1 (clear) or Class 2 (tinted) as indicated, Quality-Q3.

1. Fabrication Process: By horizontal (roller-hearth) process with roll-wave distortion parallel to bottom edge of glass as installed unless otherwise indicated.

C. Heat-Strengthened Float Glass : ASTM C1048, Kind HS (heat strengthened), Type I, Condition A (uncoated) unless otherwise indicated, Type I, Class 1 (clear) or Class 2 (tinted) as indicated, Quality-Q3.

1. Fabrication Process: By horizontal (roller-hearth) process with roll-wave distortion parallel to bottom edge of glass as installed unless otherwise indicated.

D. Reflective- and Low-E-Coated Vision Glass: ASTM C1376.

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. Cardinal Glass Industries, Inc.
   b. Guardian Glass LLC
   c. Pilkington North America; NSG Group
   d. Vitro Architectural Glass

E. Reflective- and Low-E-Coated Spandrel Glass : ASTM C1376, Kind CS.

2.5 LAMINATED GLASS

A. Laminated Glass: ASTM C1172. Use materials that have a proven record of no tendency to bubble, discolor, or lose physical and mechanical properties after fabrication and installation.

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. Dreamwalls
   b. Kuraray America, Inc.
   c. Pilkington North America; NSG Group
   d. Saflex; Eastman

2. Construction: Laminate glass with polyvinyl butyral interlayer or cast-in-place and cured-transparent-resin interlayer to comply with interlayer manufacturer's written instructions.
3. Interlayer Thickness: Provide thickness not less than that indicated and as needed to comply

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with requirements.
4. Interlayer Color: Clear unless otherwise indicated.

2.6 INSULATING GLASS UNITS

A. Insulating Glass Unit : Factory-assembled units consisting of sealed lites of glass separated by a dehydrated interspace, qualified in accordance with ASTM E2190.

1. Sealing System: Dual seal, with manufacturer's standard primary and secondary sealants.
2. Desiccant: Molecular sieve or silica gel, or a blend of both.

2.7 GLAZING SEALANTS

A. General:

1. Compatibility: Compatible with one another and with other materials they contact, including glass products, seals of insulating-glass units, and glazing channel substrates, under conditions of service and application, as demonstrated by sealant manufacturer based on testing and field experience.
2. Suitability: Comply with sealant and glass manufacturers' written instructions for selecting glazing sealants suitable for applications indicated and for conditions existing at time of installation.
3. Colors of Exposed Glazing Sealants: As selected by Architect from manufacturer's full range of industry colors.

B. Neutral-Curing Silicone Glazing Sealant, Class 100/50: Complying with ASTM C920, Type S, Grade NS, Use NT.

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. GE Construction Sealants; Momentive Performance Materials Inc.
b. Pecora Corporation
c. Sika Corporation
d. The Dow Chemical Company
e. Tremco Incorporated

2.8 GLAZING TAPES

A. Back-Bedding Mastic Glazing Tapes: Preformed, butyl-based, 100 percent solids elastomeric tape; nonstaining and nonmigrating in contact with nonporous surfaces; with or without spacer rod as recommended in writing by tape and glass manufacturers for application indicated; and complying with ASTM C1281 and AAMA 800 for products indicated below:

1. AAMA 804.3 tape, where indicated.
2. AAMA 806.3 tape, for glazing applications in which tape is subject to continuous pressure.
3. AAMA 807.3 tape, for glazing applications in which tape is not subject to continuous pressure.

B. Expanded Cellular Glazing Tapes: Closed-cell, PVC or acrylic foam tapes; factory coated with adhesive on both surfaces; and complying with AAMA 800 for the following types:

1. AAMA 810.1, Type 1, for glazing applications in which tape acts as primary sealant.
2. AAMA 810.1, Type 2, for glazing applications in which tape is used in combination with a full bead of liquid sealant.

2.9 MISCELLANEOUS GLAZING MATERIALS

A. General: Provide products of material, size, and shape complying with referenced glazing standard, recommended in writing by 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.

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C. Setting Blocks:

1. Type: Silicone with Shore A durometer hardness of 85, plus or minus 5.
2. Type recommended in writing by sealant or glass manufacturer.

D. Spacers:

1. Type: Neoprene blocks or continuous extrusions of hardness required by glass manufacturer to maintain glass lites in place for installation indicated.
2. Type recommended in writing by sealant or glass manufacturer.

E. Edge Blocks:

1. Type: Silicone with Shore A durometer hardness per manufacturer's written instructions.
2. Type recommended in writing by sealant or glass manufacturer.

F. Cylindrical Glazing Sealant Backing: ASTM C1330, Type O (open-cell material), of size and density to control glazing sealant depth and otherwise produce optimum glazing sealant performance.

2.10 FABRICATION OF GLAZING UNITS

A. Fabricate glazing units in sizes required to fit 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 publications, to comply with system performance requirements.

1. Allow for thermal movements from ambient and surface temperature changes acting on glass framing members and glazing components.

   a. Temperature Change: 120 deg F, ambient; 180 deg F, material surfaces.

B. Clean-cut or flat-grind vertical edges of butt-glazed monolithic lites to produce square edges with slight chamfers at junctions of edges and faces.

C. Grind smooth and polish exposed glass edges and corners.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine framing, glazing channels, and stops, with Installer present, for compliance with the following:

1. Manufacturing and installation tolerances, including those for size, squareness, and offsets at corners.
2. Presence and functioning of weep systems.
3. Minimum required face and edge clearances.
4. Effective sealing between joints of glass-framing members.

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

3.2 PREPARATION

A. Clean glazing channels and other framing members receiving glass immediately before glazing. Remove coatings not firmly bonded to substrates.

B. Examine glazing units to locate exterior and interior surfaces. Label or mark units as needed so that exterior and interior surfaces are readily identifiable. Do not use materials that leave visible marks in the completed Work.

3.3 GLAZING, GENERAL

A. Comply with combined written instructions of manufacturers of glass, sealants, gaskets, and other glazing materials, unless more stringent requirements are indicated, including those in referenced glazing publications.

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B. Protect glass edges from damage during handling and installation. Remove damaged glass from Project site and legally dispose of off Project site. Damaged glass includes glass with edge damage or other imperfections that, when installed, could weaken glass, impair performance, or impair appearance.

C. Apply primers to joint surfaces where required for adhesion of sealants, as determined by preconstruction testing.

D. Install setting blocks in sill rabbets, sized and located to comply with referenced glazing publications, unless otherwise required by glass manufacturer. Set blocks in thin course of compatible sealant suitable for heel bead.

E. Do not exceed edge pressures stipulated by glass manufacturers for installing glass lites.

F. Provide spacers for glass lites where length plus width is larger than **50 inches**.

1. Locate spacers directly opposite each other on both inside and outside faces of glass. Install correct size and spacing to preserve required face clearances, unless gaskets and glazing tapes are used that have demonstrated ability to maintain required face clearances and to comply with system performance requirements.
2. Provide **1/8-inch-** minimum bite of spacers on glass and use thickness equal to sealant width. With glazing tape, use thickness slightly less than final compressed thickness of tape.

G. Provide edge blocking where indicated or needed to prevent glass lites from moving sideways in glazing channel, as recommended in writing by glass manufacturer and in accordance with requirements in referenced glazing publications.

H. Set glass lites in each series with uniform pattern, draw, bow, and similar characteristics.

I. Set glass lites with proper orientation so that coatings face exterior or interior as specified.

J. Where wedge-shaped gaskets are driven into one side of channel to pressurize sealant or gasket on opposite side, provide adequate anchorage so gasket cannot walk out when installation is subjected to movement.

K. Square cut wedge-shaped gaskets at corners and install gaskets in a manner recommended by gasket manufacturer to prevent corners from pulling away; seal corner joints and butt joints with sealant recommended in writing by gasket manufacturer.

3.4 INSTALLATION OF GLAZING TAPES

A. Position tapes on fixed stops so that, when compressed by glass, their exposed edges are flush with or protrude slightly above sightline of stops.

B. Install tapes continuously, but not necessarily in one continuous length. Do not stretch tapes to make them fit opening.

C. Cover vertical framing joints by applying tapes to heads and sills first, then to jambs. Cover horizontal framing joints by applying tapes to jambs, then to heads and sills.

D. Place joints in tapes at corners of opening with adjoining lengths butted together, not lapped. Seal joints in tapes with compatible sealant approved by tape manufacturer.

E. Do not remove release paper from tape until right before each glazing unit is installed.

F. Apply heel bead of elastomeric sealant.

G. Center glass lites in openings on setting blocks, and press firmly against tape by inserting dense compression gaskets formed and installed to lock in place against faces of removable stops. Start gasket applications at corners and work toward centers of openings.

H. Apply cap bead of elastomeric sealant over exposed edge of tape.

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3.5 INSTALLATION OF GLAZING GASKET (DRY)

A. Cut compression gaskets to lengths recommended by gasket manufacturer to fit openings exactly, with allowance for stretch during installation.

B. Insert soft compression gasket between glass and frame or fixed stop so it is securely in place with joints miter cut and bonded together at corners.

C. Installation with Drive-in Wedge Gaskets: Center glass lites in openings on setting blocks, and press firmly against soft compression gasket by inserting dense compression gaskets formed and installed to lock in place against faces of removable stops. Start gasket applications at corners and work toward centers of openings. Compress gaskets to produce a weathertight seal without developing bending stresses in glass. Seal gasket joints with sealant recommended in writing by gasket manufacturer.

D. Installation with Pressure-Glazing Stops: Center glass lites in openings on setting blocks, and press firmly against soft compression gasket. Install dense compression gaskets and pressure-glazing stops, applying pressure uniformly to compression gaskets. Compress gaskets to produce a weathertight seal without developing bending stresses in glass. Seal gasket joints with sealant recommended in writing by gasket manufacturer.

E. Install gaskets so they protrude past face of glazing stops.

3.6 INSTALLATION OF GLAZING SEALANT

A. Install continuous spacers, or spacers combined with cylindrical sealant backing, between glass lites and glazing stops to maintain glass face clearances and to prevent sealant from extruding into glass channel and blocking weep systems until sealants cure. Secure spacers or spacers and backings in place and in position to control depth of installed sealant relative to edge clearance for optimum sealant performance.

B. Force sealants into glazing channels to eliminate voids and to ensure complete wetting or bond of sealant to glass and channel surfaces.

C. Tool exposed surfaces of sealants to provide a substantial wash away from glass.

3.7 CLEANING

A. Immediately after installation, remove nonpermanent labels and clean surfaces.

B. Wash glass on both exposed surfaces not more than four days before date scheduled for inspections that establish date of Substantial Completion. Wash glass as recommended in writing by glass manufacturer.

3.8 PROTECTION

A. Protect glass from contact with contaminating substances resulting from construction operations. 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 buildup of dirt, scum, alkaline deposits, or stains.

1. If, despite such protection, contaminating substances do contact with glass, remove substances immediately as recommended in writing by glass manufacturer. Remove and replace glass that cannot be cleaned without damage to coatings.

B. Remove and replace glass that is damaged during construction period.

3.9 MONOLITHIC GLASS SCHEDULE

A. Clear Glass Type: Heat-strengthened float glass GL-4 or GL-4T.

1. Minimum Thickness: 6 mm.
2. Safety glazing required.

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B. Tinted Glass Type: Heat-strengthened float glass .

1. Tint Color: As indicated in the drawings.
2. Minimum Thickness: 6 mm.
3. Winter Nighttime U-Factor: As indicated in the drawings maximum.
4. Summer Daytime U-Factor: As indicated in the drawings maximum.
5. Visible Light Transmittance: As indicated in the drawings percent minimum.
6. SHGC: As indicated in the drawings maximum.
7. Safety glazing required.

C. Reflective-Coated Spandrel Glass Type: Heat-strengthened float glass .

1. Coating Type: Pyrolytic or Sputter-coating (vacuum deposition process).
2. Coating Color: As selected.
3. Glass: Clear or Tinted float glass to match primary exterior glass.
4. Tint Color: As indicated in drawings.
5. Minimum Thickness: 6 mm.
6. Coating Location: Second surface.
7. Outdoor Visible Reflectance: As indicated in drawings percent maximum.
8. Winter Nighttime U-Factor: As indicated in the drawings maximum.
9. Summer Daytime U-Factor: As indicated in the drawings maximum.
10. Fallout Resistance: Passes fallout-resistance test in ASTM C1048 for an assembly of glass and adhered reinforcing material.
11. Factory apply manufacturer's standard opacifier of the following material to coated on second surface of lites, with resulting products complying with Specification No. 89 in NGA's "Engineering Standards Manual":

    a. Manufacturer's standard opacifier material.
    b. Polyester film laminated to glass with solvent-based adhesive.

3.10 LAMINATED GLASS SCHEDULE

A. Clear Laminated Glass Type: Two plies of heat-strengthened float glass .

1. Minimum Thickness of Each Glass Ply: 4 mm.
2. Interlayer Thickness: 0.030 inch.
3. Safety glazing required.

B. Laminated Tinted Glass Type: Two plies of heat-strengthened float glass with outer ply tinted and inner ply clear .

1. Tint Color: As indicated in the drawings.
2. Minimum Thickness of Each Glass Ply: 4 mm.
3. Interlayer Thickness: 0.030 inch.
4. Safety glazing required.

3.11 INSULATING GLASS SCHEDULE

A. Low-E-Coated, Clear Insulating Glass Type: GL-1 or GL-1T.

1. Basis-of-Design Product: PPG Solarban 70.
2. Overall Unit Thickness: 1 inch.
3. Minimum Thickness of Each Glass Lite: 4 mm.
4. Outdoor Lite: Heat-strengthened float glass.
5. Interspace Content: Argon.
6. Indoor Lite: Heat-strengthened float glass.
7. Low-E Coating: Pyrolytic or sputtered on second or third surface.
8. Winter Nighttime U-Factor: As indicated in the drawings .
9. Summer Daytime U-Factor: As indicated in the drawings .
10. Visible Light Transmittance: As indicated in the drawings .
11. SHGC: As indicated in the drawings .
12. Safety glazing required.

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B. Low-E-Coated, Tinted Insulating Glass Type: GL-2 or GL-2T.

1. Basis-of-Design Product: PPG Solarban 70 Tinted.
2. Overall Unit Thickness: 1 inch.
3. Minimum Thickness of Each Glass Lite: 4 mm.
4. Outdoor Lite: Tinted heat-strengthened float glass.
5. Tint Color: As indicated in the drawings or as selected by Archtiect.
6. Interspace Content: Argon.
7. Indoor Lite: Clear heat-strengthened float glass.
8. Low-E Coating: Pyrolytic or sputtered on second or third surface.
9. Winter Nighttime U-Factor: As indicated in the drawings .
10. Summer Daytime U-Factor: As indicated in the drawings .
11. Visible Light Transmittance: As indicated in the drawings .
12. SHGC: As indicated in the drawings .
13. Safety glazing required.

C. Ceramic-Coated, Insulating Spandrel Glass Type: GL-3 or GL-3T.

1. Basis-of-Design Product: PPG Solarban 70.
2. Coating Color: As selected by Architect from manufacturer's full range.
3. Overall Unit Thickness: 1 inch.
4. Minimum Thickness of Each Glass Lite: 5 mm.
5. Outdoor Lite: Clear heat-strengthened float glass.
6. Interspace Content: Argon.
7. Indoor Lite: Clear heat-strengthened float glass.
8. Coating Location: Fourth surface.
9. Winter Nighttime U-Factor: As indicated in the drawings .
10. Summer Daytime U-Factor: As indicated in the drawings .

END OF SECTION 08 80 00

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SECTION 09 22 16 - NON-STRUCTURAL METAL FRAMING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Nonstructural steel framing.
2. Grid suspension systems.

B. Related Requirements:

1. Section 054000 "Cold-Formed Metal Framing" for exterior and interior load-bearing, structural framing.

1.2 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of specified product.

B. Shop Drawings:

1. Include layout, spacings, sizes, thicknesses, and types of nonstructural steel framing and fastening and anchorage details.
2. Indicate reinforcing channels, opening framing, supplemental framing, strapping, bracing, bridging, splices, accessories, and attachments to adjoining work.

1.4 INFORMATIONAL SUBMITTALS

A. Product Certificates: For code-compliance certification of studs and track.

B. Evaluation Reports: From ICC-ES showing compliance with Project requirements, for the following:

1. Studs and track.
2. High-strength steel studs and track.
3. Equivalent corrosion-resistant coating on steel framing.
4. Firestop track.
5. Post-installed anchors.
6. Power-actuated anchors.

1.5 QUALITY ASSURANCE

A. Code-Compliance Certification of Studs and Track: Provide documentation that framing members are certified in accordance with product-certification program of the Steel Framing Industry Association.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Deliver materials in manufacturer's original, unopened, undamaged containers with identification labels intact.

B. Protect materials from corrosion, deformation, and other damage during delivery, storage, and handling in accordance with AISI S202.

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PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Fire-Test-Response Characteristics: Where indicated on Drawings, provide assemblies incorporating nonstructural steel framing identical to those of assemblies tested for fire resistance in accordance with ASTM E119 by an independent testing agency.

B. STC-Rated Assemblies: Where indicated on Drawings, provide assemblies incorporating nonstructural steel framing identical to those of assemblies tested in accordance with ASTM E90 and classified in accordance with ASTM E413 by an independent testing agency.

C. Horizontal Deflection: For non-composite wall assemblies, limited to 1/240 of the wall height based on the following horizontal loading:

1. Horizontal Loading: 5 lbf/sq. ft..

2.2 NONSTRUCTURAL STEEL FRAMING

A. Recycled Content of Steel Products: Postconsumer recycled content plus one-half of preconsumer recycled content not less than 25 percent.

B. Framing Members, General: Comply with requirements in AISI S220 for conditions indicated on Drawings.

1. Protective Coating: ASTM A653/A653M, G40 hot-dip galvanized or coating with demonstrated equivalent corrosion resistance. Galvannealed products are unacceptable.

a. Equivalent Corrosion-Resistant Coating: Evaluation report acceptable to authorities having jurisdiction demonstrates corrosion resistance equivalent to specified protective coating.

C. Studs and Track: Conventional members, roll-formed into standard shapes without surface deformations to stiffen framing members.

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. CEMCO; California Expanded Metal Products Co.
b. ClarkDietrich
c. CRACO Mfg., Inc.
d. Jaimes Industries, Inc.
e. Marino\WARE
f. MBA Building Supplies
g. MBA Metal Framing
h. MRI Steel Framing, LLC
i. SCAFCO Steel Stud Company; Stone Group of Companies
j. Steel Construction Systems; Stone Group of Companies
k. Steel Network, Inc. (The)
l. TELLING Industries
m. UMS Metal Building Systems USA LLC
n. US Frame Factory

2. Minimum Base-Steel Thickness: As indicated on Drawings.
3. Minimum Yield Strength: **33 ksi**.
4. Depth: As indicated on Drawings.

D. Slip-Type Head Joints: Where indicated on Drawings.

1. Clip System: Clips designed for use in head-of-wall deflection conditions that provide a positive attachment of studs to track.

a. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to,

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the following:

1) CEMCO; California Expanded Metal Products Co.
2) ClarkDietrich
3) CRACO Mfg., Inc.
4) Marino\WARE
5) MBA Metal Framing
6) SCAFCO Steel Stud Company; Stone Group of Companies
7) Steel Construction Systems; Stone Group of Companies
8) Steel Network, Inc. (The)
9) Super Stud Building Products Inc.
10) US Frame Factory

b. Minimum Allowable Vertical Movement: 1-1/2 inches.

2. Single Long-Leg Track: Top track with solid, deep flanges in base-steel thickness not less than that of studs, installed with studs friction fit into track and with continuous bridging located within **12 inches** of the top of studs to provide lateral bracing.

a. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1) CEMCO; California Expanded Metal Products Co.
2) ClarkDietrich
3) Jaimes Industries, Inc.
4) Marino\WARE
5) MBA Building Supplies
6) MRI Steel Framing, LLC
7) SCAFCO Steel Stud Company; Stone Group of Companies
8) Steel Construction Systems; Stone Group of Companies
9) Steel Network, Inc. (The)
10) TELLING Industries
11) The Mill Steel Co
12) US Frame Factory

b. Flange Length: 2 inches.

3. Slotted Deflection Track: Steel sheet top track manufactured with deep flanges that allow positive attachment to studs through long slots and prevent deflection of structure above from cracking finishes applied to framing; in base-steel thickness not less than that of studs and in width to accommodate depth of studs.

a. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1) CEMCO; California Expanded Metal Products Co.
2) ClarkDietrich
3) Marino\WARE
4) MBA Building Supplies
5) MRI Steel Framing, LLC
6) SCAFCO Steel Stud Company; Stone Group of Companies
7) Steel Construction Systems; Stone Group of Companies
8) Steel Network, Inc. (The)
9) TELLING Industries
10) The Mill Steel Co

b. Flange Length: 2-1/2 inches.

E. Firestop Track: Top track manufactured to allow partition heads to expand and contract with movement of structure above while maintaining continuity of fire-resistance-rated assembly indicated on Drawings; in base-steel thickness not less than that of studs and in width to accommodate depth of studs.

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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. CEMCO; California Expanded Metal Products Co.
    b. ClarkDietrich
    c. Fire Trak Corp
    d. Marino\WARE
    e. Metal-Lite
    f. SCAFCO Steel Stud Company; Stone Group of Companies
    g. Steel Construction Systems; Stone Group of Companies
    h. Steel Network, Inc. (The)
    i. TELLING Industries

F. Flat Strap and Backing Plate: Steel sheet for blocking and bracing in length and width indicated on Drawings.

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. CEMCO; California Expanded Metal Products Co.
    b. ClarkDietrich
    c. Jaimes Industries, Inc.
    d. Marino\WARE
    e. MBA Building Supplies
    f. MRI Steel Framing, LLC
    g. Phillips Manufacturing Co
    h. SCAFCO Steel Stud Company; Stone Group of Companies
    i. Steel Construction Systems; Stone Group of Companies
    j. Steel Network, Inc. (The)
    k. TELLING Industries
    l. The Mill Steel Co
    m. US Frame Factory

2. Minimum Base-Steel Thickness: 0.0179 inch.

G. U-Channel: Cold-rolled steel, **0.0538-inch** minimum base-steel thickness, with minimum **1/2-inch-**wide flanges.

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. CEMCO; California Expanded Metal Products Co.
    b. ClarkDietrich
    c. CRACO Mfg., Inc.
    d. Jaimes Industries, Inc.
    e. Marino\WARE
    f. MBA Building Supplies
    g. MRI Steel Framing, LLC
    h. Phillips Manufacturing Co
    i. SCAFCO Steel Stud Company; Stone Group of Companies
    j. Steel Construction Systems; Stone Group of Companies
    k. Steel Network, Inc. (The)
    l. TELLING Industries
    m. The Mill Steel Co
    n. UMS Metal Building Systems USA LLC
    o. US Frame Factory

2. Depth:

    a. Bridging: As indicated on Drawings or 1-1/2 inches.
    b. Suspended-Assembly Carrying Channels (Main Runners): As indicated on Drawings or 2 inches.
    c. Suspended-Assembly Furring Channels (Furring Members): 3/4 inch.

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3. Bridging Clip Angle: Not less than **1-1/2 by 1-1/2 inches**; **0.068-inch-** base-steel thickness.

H. Rigid Hat-Shaped Furring Channels: Conventional members, roll-formed into standard shapes.

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. CEMCO; California Expanded Metal Products Co.
   b. ClarkDietrich
   c. CRACO Mfg., Inc.
   d. Jaimes Industries, Inc.
   e. Marino\WARE
   f. MBA Building Supplies
   g. MBA Metal Framing
   h. MRI Steel Framing, LLC
   i. Phillips Manufacturing Co
   j. SCAFCO Steel Stud Company; Stone Group of Companies
   k. Steel Construction Systems; Stone Group of Companies
   l. Steel Network, Inc. (The)
   m. TELLING Industries
   n. The Mill Steel Co
   o. UMS Metal Building Systems USA LLC
   p. US Frame Factory

2. Minimum Base-Steel Thickness: 0.0179 inch.
3. Depth: As indicated on Drawings.

I. Resilient Furring Channels: **1/2-inch-** deep, steel sheet members designed to reduce sound transmission.

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. CEMCO; California Expanded Metal Products Co.
   b. ClarkDietrich
   c. CRACO Mfg., Inc.
   d. Jaimes Industries, Inc.
   e. Marino\WARE
   f. MBA Building Supplies
   g. MRI Steel Framing, LLC
   h. Phillips Manufacturing Co
   i. SCAFCO Steel Stud Company; Stone Group of Companies
   j. Steel Construction Systems; Stone Group of Companies
   k. Steel Network, Inc. (The)
   l. TELLING Industries
   m. The Mill Steel Co
   n. US Frame Factory

2. Configuration: hat shaped.

J. Z-Shaped Furring: With slotted or nonslotted web, face flange of **1-1/4 inches**, wall attachment flange of **3/4 inch**, minimum base-steel thickness of **0.0179 inch**, and depth required to fit insulation thickness indicated on Drawings.

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. CEMCO; California Expanded Metal Products Co.
   b. ClarkDietrich
   c. CRACO Mfg., Inc.
   d. Jaimes Industries, Inc.
   e. Marino\WARE
   f. MBA Building Supplies
   g. MBA Metal Framing

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h. MRI Steel Framing, LLC
i. Phillips Manufacturing Co
j. SCAFCO Steel Stud Company; Stone Group of Companies
k. Steel Construction Systems; Stone Group of Companies
l. Steel Network, Inc. (The)
m. TELLING Industries
n. The Mill Steel Co
o. US Frame Factory

2.3 GRID SUSPENSION SYSTEMS

A. Grid Suspension Systems for Gypsum Board Ceilings: ASTM C645, direct-hung system composed of main beams and cross-furring members that interlock.

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. Armstrong World Industries
b. CertainTeed; Saint-Gobain North America
c. Rockfon; ROCKWOOL International
d. USG Corporation

2.4 AUXILIARY MATERIALS

A. General: Provide auxiliary materials that comply with referenced installation standards.

1. Fasteners for Steel Framing: Of type, material, size, corrosion resistance, holding power, and other properties required to fasten steel members to substrates.

B. Adjustable Wall-Furring Brackets: Steel sheet in minimum **0.0329-inch-** base-steel thickness with serrated edges for attaching furring channels to exterior masonry or concrete walls.

1. Protective Coating: ASTM A653/A653M, G40, hot-dip galvanized.

C. Tie Wire: ASTM A641/A641M, Class 1 zinc coating, soft temper.

1. Tire Wire for Adjustable Wall-Furring Brackets: Use minimum double strand of **0.0625-inch-** diameter wire, or triple strand of **0.0475-inch-** diameter wire to attach furring channels.
2. Tire Wire for Suspended-Ceiling Systems:

a. Splicing Carrying Channels and Furring Members: Use double loops of minimum **0.0625-inch-** diameter wire.
b. Saddle Tying Main Runners and Cross Furring: Use minimum **0.0625-inch-** diameter wire, or double strand of **0.0475-inch-** diameter wire.

D. Post-Installed Anchors: Fastener systems with an evaluation report, acceptable to authorities having jurisdiction, as appropriate for the substrate.

1. Securing Hangers:

a. Acceptance Criteria: ICC-ES AC01 AC193 AC58 or AC308.
b. Type: Torque-controlled, expansion anchor torque-controlled, adhesive anchor or adhesive anchor.
c. Material for Interior Locations: Carbon-steel components zinc-plated to comply with ASTM B633 or ASTM F1941/F1941M, Class Fe/Zn 5, unless otherwise indicated on Drawings.
d. Stainless Steel Material for Exterior or Interior Locations: Alloy Group 1 stainless steel bolts, ASTM F593, and nuts, ASTM F594.

E. Power-Actuated Anchors: Fastener systems with an evaluation report, acceptable to authorities having jurisdiction, based on ICC-ES AC70.

F. Wire Hangers: ASTM A641/A641M, Class 1 zinc coating, soft temper.

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1. Diameter: 0.162 inch.

G. Flat Hangers: Steel sheet.

1. Protective Coating: ASTM A653/A653M, G40, hot-dip galvanized.
2. Size and Length: In size indicated on Drawings.

H. Isolation Strip at Exterior Walls: Provide the following:

1. Foam Gasket: Adhesive-backed, closed-cell vinyl foam strips that allow fastener penetration without foam displacement, **1/8 inch** thick, in width to suit steel stud size.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas, substrates, and conditions, with Installer present, for compliance with requirements and other conditions affecting performance of the Work.

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

3.2 PREPARATION

A. Suspended Assemblies: Coordinate installation of suspension systems with installation of overhead structure to ensure that inserts and other provisions for anchorages to building structure have been installed to receive hangers at spacing required to support the Work and that hangers will develop their full strength.

1. Furnish concrete inserts and other devices required to other trades for installation in advance of time needed for coordination and construction.

B. Coordination with Sprayed Fire-Resistive Materials:

1. Before sprayed fire-resistive materials are applied, attach offset anchor plates or ceiling track to surfaces indicated on Drawings to receive sprayed fire-resistive materials. Where offset anchor plates are required, provide continuous plates fastened to building structure not more than **24 inches** o.c.
2. After sprayed fire-resistive materials are applied, remove them only to extent necessary for installation of nonstructural steel framing. Do not reduce thickness of fire-resistive materials below that required for fire-resistance ratings indicated on Drawings. Protect adjacent fire-resistive materials from damage.

3.3 INSTALLATION OF NONSTRUCTURAL STEEL FRAMING, GENERAL

A. Installation Standard: ASTM C754.

1. Gypsum Plaster Assemblies: Also comply with requirements in ASTM C841 that apply to framing installation.
2. Portland Cement Plaster Assemblies: Also comply with requirements in ASTM C1063 that apply to framing installation.
3. Gypsum Veneer Plaster Assemblies: Also comply with requirements in ASTM C844 that apply to framing installation.
4. Gypsum Board Assemblies: Also comply with requirements in ASTM C840 that apply to framing installation.

B. Install framing and accessories plumb, square, and true to line, with connections securely fastened.

C. Install supplementary framing, and blocking to support fixtures, equipment services, heavy trim, grab bars, toilet accessories, furnishings, or similar construction.

D. Install bracing at terminations in assemblies.

E. Do not bridge building control and expansion joints with framing members. Frame both sides of joints independently.

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3.4 INSTALLATION OF NONSTRUCTURAL STEEL FRAMING

A. Install framing system components at spacings indicated on Drawings, but not greater than spacings required by referenced installation standards for assembly types.

1. Single-Layer Application: 16 inches o.c. unless otherwise indicated on Drawings.
2. Multilayer Application: 16 inches o.c. unless otherwise indicated on Drawings.
3. Tile Backing Panels: 16 inches o.c. unless otherwise indicated on Drawings.

B. Where studs are installed directly against exterior masonry walls or dissimilar metals at exterior walls, install isolation strip between studs and exterior wall.

C. Install studs so flanges within framing system point in same direction.

D. Install track at floors and overhead supports. Extend framing full height to structural supports or substrates above suspended ceilings except where partitions are indicated on Drawings to terminate at suspended ceilings. Continue framing around ducts that penetrate partitions above ceiling.

1. Slip-Type Head Joints: Where framing extends to overhead structural supports, install to produce joints at tops of framing systems that prevent axial loading of finished assemblies.
2. Door Openings: Screw vertical studs at jambs to jamb anchor clips on door frames; install track section (for cripple studs) at head and secure to jamb studs.

   a. Install two studs at each jamb unless otherwise indicated on Drawings.
   b. Install cripple studs at head adjacent to each jamb stud, with a minimum **1/2-inch** clearance from jamb stud to allow for installation of control joint in finished assembly.
   c. Extend jamb studs through suspended ceilings and attach to underside of overhead structure unless otherwise indicated on Drawings.

3. Other Framed Openings: Frame openings other than door openings the same as required for door openings unless otherwise indicated on Drawings. Install framing below sills of openings to match framing required above door heads.
4. Fire-Resistance-Rated Partitions: Install framing to comply with fire-resistance-rated assembly indicated on Drawings and support closures to make partitions continuous from floor to underside of solid structure.

   a. Firestop Track: Install to maintain continuity of fire-resistance-rated assembly indicated on Drawings.

5. STC-Rated Partitions: Install framing to comply with STC-rated assembly indicated on Drawings.
6. Curved Partitions:

   a. Bend track to uniform curve and locate straight lengths so they are tangent to arcs.
   b. Begin and end each arc with a stud, and space intermediate studs equally along arcs. On straight lengths of at least two studs at ends of arcs, place studs **6 inches** o.c.

E. Direct Furring:

1. Screw to wood framing.
2. Attach to concrete or masonry with stub nails, screws designed for masonry attachment, or powder-driven fasteners spaced **24 inches** o.c.

F. Adjustable Wall-Furring Brackets: Install brackets with serrated edges facing upward spaced at minimum **48 inches** o.c. vertically with **6 inches** maximum from floor and ceiling, and minimum **36 inches** o.c. horizontally with **4 inches** maximum from abutting construction, unless otherwise indicated on Drawings.

G. Z-Shaped Furring:

1. Install insulation, specified in Section 072100 "Thermal Insulation," vertically and hold in place with Z-shaped furring members spaced 24 inches o.c.
2. Except at exterior corners, securely attach narrow flanges of furring members to wall with concrete stub nails, screws designed for masonry attachment, or powder-driven fasteners spaced **24 inches** o.c.

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3. At exterior corners, attach wide flange of furring members to wall with short flange extending beyond corner; on adjacent wall surface, screw-attach short flange of furring channel to web of attached channel. At interior corners, space second member no more than **12 inches** from corner and cut insulation to fit.

H. Suspended Assemblies: Isolate suspension assemblies from building structure where they abut or are penetrated by building structure to prevent transfer of loading imposed by structural movement.

1. Hangers: Install hangers plumb and free from contact with insulation or other objects within ceiling plenum that are not part of supporting structural or suspension system spaced as indicated on Drawings.

a. Splay hangers only where required to miss obstructions and offset resulting horizontal forces by bracing, countersplaying, or other equally effective means.
b. Where width of ducts and other construction within ceiling plenum produces hanger spacings that interfere with locations of hangers required to support standard suspension system members, install supplemental suspension members and hangers in the form of trapezes or equivalent devices.

1) Size supplemental suspension members and hangers to support ceiling loads within performance limits established by referenced installation standards.

c. Wire Hangers: Secure by looping and wire tying, either directly to structures or to inserts, eye screws, or other devices and fasteners that are secure and appropriate for substrate, and in a manner that will not cause hangers to deteriorate or otherwise fail.
d. Flat Hangers: Secure to structure, including intermediate framing members, by attaching to inserts, eye screws, or other devices and fasteners that are secure and appropriate for structure and hanger, and in a manner that will not cause hangers to deteriorate or otherwise fail.
e. Do not attach hangers to steel roof deck.
f. Do not attach hangers to permanent metal forms. Furnish cast-in-place hanger inserts that extend through forms.
g. Do not attach hangers to rolled-in hanger tabs of composite steel floor deck.
h. Do not connect or suspend framing from ducts, pipes, or conduit.

2. U-Channels: Carrying channels (main runners) spaced as indicated on Drawings.
3. Furring Channels (Furring Members): As indicated on Drawings.

a. Spacing: As indicated on Drawings.
b. Fire-Resistance-Rated Assemblies: Wire tie furring channels to supports.

4. Seismic Bracing: Sway-brace suspension systems with hangers used for support.

I. Installation Tolerances for Nonstructural Steel Framing:

1. Framing Members: Install each framing member so fastening surfaces vary not more than **1/8 inch** from the plane formed by faces of adjacent framing.
2. Suspended Assemblies: Install suspension systems that are level to within 1/8 inch in 12 ft. measured lengthwise on each member that will receive finishes and transversely between parallel members that will receive finishes.

3.5 INSTALLATION OF GRID SUSPENSION SYSTEMS

A. Grid Suspension Systems: Install in accordance with manufacturer's written instructions. Attach perimeter wall track or angle where grid suspension systems meet vertical surfaces. Mechanically join main beam and cross-furring members to each other and butt-cut to fit into wall track.

B. Installation Tolerances for Grid Suspension Systems: Install suspension systems that are level to within 1/8 inch in 12 ft. measured lengthwise on each member that will receive finishes and transversely between parallel members that will receive finishes.

END OF SECTION 09 22 16

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SECTION 09 29 00 - GYPSUM BOARD

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Interior gypsum board.
2. Exterior gypsum board.
3. Tile backing panels.

B. Related Requirements:

1. Section 061600 "Sheathing" for gypsum sheathing for exterior applications.
2. Section 079219 "Acoustical Joint Sealants" for acoustical joint sealants installed in gypsum board assemblies.
3. Section 092216 "Non-Structural Metal Framing" for nonstructural steel framing and suspension systems that support gypsum board panels.
4. Section 093013 "Ceramic Tiling" for tile backing panels installed as substrates for ceramic tile.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of specified product.

B. Shop Drawings: Locations and installation of control and expansion joints, including plans, elevations, sections, and attachment details.

C. Samples for Initial Selection:

1. Trim Accessories: For aluminum trim.
2. Texture Finish: For each type required.

D. Samples for Verification: Actual sample of finished products for the following:

1. Trim Accessories: Actual sample of finished products for each profile of aluminum trim.

   a. Size: Full size profile, 12 inches long.

2. Texture Finish: Manufacturer's standard size for each texture finish required and on same backing indicated for Work.

1.3 MOCKUPS

A. Build mockups of at least 100 sq. ft. in surface area to demonstrate aesthetic effects and to set quality standards for materials and execution.

1. Build mockups for the following:

   a. Each level of interior gypsum board finish required for use in exposed locations.
   b. Each texture finish required.

2. Apply or install final decoration required, including painting and wallcoverings, on exposed surfaces for review of mockups.
3. Simulate finished lighting conditions for review of mockups.
4. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Owner specifically approves such deviations by Change Order.
5. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

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1.4 DELIVERY, STORAGE, AND HANDLING

A. Store materials inside under cover and keep them dry and protected against weather, condensation, direct sunlight, construction traffic, and other potential causes of damage. Stack panels flat and supported on risers on a flat platform to prevent sagging.

1.5 FIELD CONDITIONS

A. Environmental Limitations: Comply with ASTM C840 requirements or manufacturer's written instructions, whichever are more stringent.

B. Do not install paper-faced gypsum panels until installation areas are enclosed and conditioned.

C. Do not install panels that are wet, moisture damaged, or mold damaged.

1. Indications that panels are wet or moisture damaged include, but are not limited to, discoloration, sagging, or irregular shape.
2. Indications that panels are mold damaged include, but are not limited to, fuzzy or splotchy surface contamination and discoloration.

PART 2 - PRODUCTS

2.1 SOURCE LIMITATIONS

A. Obtain each type of gypsum board and joint finishing material from single source with resources to provide products of consistent quality in appearance and physical properties.

2.2 PERFORMANCE REQUIREMENTS

A. Fire-Resistance-Rated Assemblies: For fire-resistance-rated assemblies, provide materials and construction identical to those tested in assembly indicated on Drawings in accordance with ASTM E119; tested by a qualified testing agency.

B. STC-Rated Assemblies: For STC-rated assemblies, provide materials and construction identical to those tested in assembly indicated on Drawings in accordance with ASTM E90 and classified in accordance with ASTM E413; tested by a qualified testing agency.

2.3 GYPSUM BOARD, GENERAL

A. Recycled Content: Postconsumer recycled content plus one-half of preconsumer recycled content not less than <**Insert number**> percent.

B. Size: Provide panel products in maximum lengths and widths available that will minimize joints in each area and that correspond with support system specified or indicated on Drawings.

2.4 INTERIOR GYPSUM BOARD

A. Gypsum Wallboard: ASTM C1396/C1396M.

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. American Gypsum
   b. CertainTeed; Saint-Gobain North America
   c. Georgia-Pacific Gypsum LLC
   d. Gold Bond Building Products, LLC provided by National Gypsum Company
   e. PABCO Gypsum
   f. USG Corporation

2. Thickness: As indicated on Drawings.
3. Long Edges: Tapered.

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B. Gypsum Board, Type X: ASTM C1396/C1396M.

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. American Gypsum
   b. CertainTeed; Saint-Gobain North America
   c. Georgia-Pacific Gypsum LLC
   d. Gold Bond Building Products, LLC provided by National Gypsum Company
   e. PABCO Gypsum
   f. USG Corporation

2. Thickness: 5/8 inch.
3. Long Edges: Tapered.

C. Gypsum Ceiling Board: ASTM C1396/C1396M.

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. American Gypsum
   b. CertainTeed; Saint-Gobain North America
   c. Georgia-Pacific Gypsum LLC
   d. Gold Bond Building Products, LLC provided by National Gypsum Company
   e. PABCO Gypsum
   f. USG Corporation

2. Thickness: As indicated on Drawings.
3. Long Edges: Tapered.

D. Trim for Interior Gypsum Board: ASTM C1047.

1. Material: Galvanized-steel sheet or aluminum-coated steel sheet, rolled zinc, plastic, or paper-faced galvanized-steel sheet.
2. Shapes:

   a. Cornerbead.
   b. Bullnose bead.
   c. LC-Bead: J-shaped; exposed long flange receives joint compound.
   d. L-Bead: L-shaped; exposed long flange receives joint compound.
   e. U-Bead: J-shaped; exposed short flange does not receive joint compound.
   f. Curved-Edge Cornerbead: With notched or flexible flanges.
   g. Expansion (Control) Joint: One-piece, rolled zinc with V-shaped slot and removable strip covering slot opening.

E. Joint Treatment Materials for Interior Gypsum Board: Comply with ASTM C475/C475M requirements.

1. Joint Tape: Paper.
2. Joint Compound: For each coat, use formulation that is compatible with other compounds applied on previous or for successive coats.

   a. Mold-Resistant Joint Compound: Use mold-resistant formulations with mold-resistant gypsum board products.
   b. Prefilling: At open joints and damaged surface areas, use setting-type taping compound.
   c. Embedding and First Coat: For embedding tape and first coat on joints, fasteners, and trim flanges, use setting-type taping compound.
   d. Fill Coat: For second coat, use setting-type, sandable topping compound.
   e. Finish Coat: For third coat, use setting-type, sandable topping compound.
   f. Skim Coat: For final coat of Level 5 finish, use setting-type, sandable topping compound.

2.5 EXTERIOR GYPSUM BOARD

A. Exterior Gypsum Soffit Board: ASTM C1396/C1396M, with manufacturer's standard edges.

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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. American Gypsum
    b. CertainTeed; Saint-Gobain North America
    c. Georgia-Pacific Gypsum LLC
    d. Gold Bond Building Products, LLC provided by National Gypsum Company
    e. PABCO Gypsum

2. Core: 5/8 inch, Type X.

B. Trim for Exterior Gypsum Board: ASTM C1047.

1. Material: Hot-dip galvanized-steel sheet, plastic, or rolled zinc.
2. Shapes:

    a. Cornerbead.
    b. LC-Bead: J-shaped; exposed long flange receives joint compound.
    c. Expansion (Control) Joint: One-piece, rolled zinc with V-shaped slot and removable strip covering slot opening.

C. Joint Treatment Materials for Exterior Gypsum Board: Comply with ASTM C475/C475M requirements.

1. Joint Tape: Paper.
2. Joint Compound: Use setting-type taping compound and setting-type, sandable topping compound.

2.6 TILE BACKING PANELS

A. Glass-Mat, Water-Resistant Gypsum Panel: ASTM C1658/C1658M, with fiberglass mat partially or completely embedded into the core.

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

    a. CertainTeed; Saint-Gobain North America
    b. Georgia-Pacific Gypsum LLC
    c. Gold Bond Building Products, LLC provided by National Gypsum Company
    d. PABCO Gypsum
    e. USG Corporation

2. Core: 5/8 inch, Type X.
3. Long Edges: Tapered.
4. Mold Resistance: ASTM D3273, score of 10 as rated in accordance with ASTM D3274.

B. Coated Glass-Mat, Water-Resistant Gypsum Backing Panel: ASTM C1178/C1178M, with a water-resistant coating on one surface, and manufacturer's standard edges.

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

    a. CertainTeed; Saint-Gobain North America
    b. Georgia-Pacific Gypsum LLC
    c. USG Corporation

2. Core: 5/8 inch, Type X.
3. Mold Resistance: ASTM D3273, score of 10 as rated in accordance with ASTM D3274.

C. Water-Resistant Gypsum Backing Board: ASTM C1396/C1396M, with manufacturer's standard edges.

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. American Gypsum
    b. CertainTeed; Saint-Gobain North America

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c. Gold Bond Building Products, LLC provided by National Gypsum Company

2. Core: 5/8 inch, Type X.

D. Joint Treatment Materials for Tile Backing Panels: Comply with ASTM C475/C475M requirements.

1. Mold-Resistant Joint Compound: Use mold-resistant formulations with mold-resistant panel products.
2. Joint Tape: As recommended in writing by panel manufacturer.
3. Joint Compound for Tile Backing Panels:

a. Glass-Mat, Water-Resistant Gypsum Panel: As recommended in writing by panel manufacturer.
b. Coated Glass-Mat, Water-Resistant Gypsum Backing Panel: As recommended in writing by panel manufacturer.
c. Water-Resistant Gypsum Backing Board: Use setting-type taping compound and setting-type, sandable topping compound.

2.7 AUXILIARY MATERIALS

A. Provide auxiliary materials that comply with referenced installation standards and manufacturer's written instructions.

B. Laminating Adhesive: Adhesive or joint compound recommended in writing by manufacturer for directly adhering gypsum panels to continuous substrate.

C. Steel Drill Screws: ASTM C1002 unless otherwise specified or indicated on Drawings.

1. Use screws complying with ASTM C954 for fastening panels to steel members from **0.033 to 0.112 inch** thick.

D. Sound-Attenuation Blankets: ASTM C665, Type I (blankets without membrane facing) produced by combining thermosetting resins with mineral fibers as follows:

1. Non-Fire-Resistance-Rated Assemblies: Glass or slag or rock wool.
2. Fire-Resistance-Rated Assemblies: Comply with mineral-fiber requirements of assembly.

E. Acoustical Sealant: As specified in Section 079219 "Acoustical Joint Sealants."

F. Thermal Insulation: As specified in Section 072100 "Thermal Insulation."

G. Vapor Retarder: As specified in Section 072600 "Vapor Retarders."

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas and substrates including welded hollow-metal frames and support framing, with Installer present, for compliance with requirements and other conditions affecting performance of the Work.

B. Examine panels before installation. Reject panels that are wet, moisture damaged, or mold damaged.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION AND FINISHING OF GYPSUM BOARD, GENERAL

A. Comply with ASTM C840 requirements.

B. Install ceiling panels across framing to minimize the number of abutting end joints and to avoid abutting end joints in central area of each ceiling. Stagger abutting end joints of adjacent panels not less than one framing member.

C. Install panels with face side out. Butt panels together for a light contact at edges and ends with not

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more than **1/16 inch** of open space between panels. Do not force into place.

D. Locate edge and end joints over supports, except in ceiling applications where intermediate supports or gypsum board back-blocking is provided behind end joints. Do not place tapered edges against cut edges or ends. Stagger vertical joints on opposite sides of partitions. Do not make joints other than control joints at corners of framed openings.

E. Form expansion (control) joints with space between edges of adjoining gypsum panels.

F. Cover both faces of support framing with gypsum panels in concealed spaces (above ceilings, etc.), except in chases braced internally.

1. Unless concealed application is indicated or required for sound, fire, air, or smoke ratings, coverage may be accomplished with scraps of not less than **8 sq. ft.** in area.
2. Fit gypsum panels around ducts, pipes, and conduits.
3. Where partitions intersect structural members projecting below underside of floor/roof slabs and decks, cut gypsum panels to fit profile formed by structural members; allow **1/4- to 3/8-inch-** wide joints to install sealant.

G. Isolate perimeter of gypsum board applied to non-load-bearing partitions at structural abutments. Provide **1/4- to 1/2-inch-** wide spaces at these locations and trim edges with edge trim where edges of panels are exposed. Seal joints between edges and abutting structural surfaces with acoustical sealant.

H. Attachment to Steel Framing: Attach panels so leading edge or end of each panel is attached to open (unsupported) edges of stud flanges first.

I. Wood Framing: Install gypsum panels over wood framing, with floating internal corner construction. Do not attach gypsum panels across the flat grain of wide-dimension lumber, including floor joists and headers. Float gypsum panels over these members or provide control joints to counteract wood shrinkage.

J. STC-Rated Assemblies: Seal construction at perimeters, behind control joints, and at openings and penetrations with a continuous bead of acoustical sealant. Install acoustical sealant at both faces of partitions at perimeters and through penetrations. Comply with ASTM C919 requirements and with manufacturer's written instructions for locating edge trim and closing off sound-flanking paths around or through assemblies, including sealing partitions above acoustical ceilings.

K. Install sound-attenuation blankets before installing gypsum panels unless blankets are readily installed after panels have been installed on one side.

3.3 INSTALLATION OF INTERIOR GYPSUM BOARD

A. Single-Layer Application:

1. On ceilings, apply gypsum panels before wall/partition board application to greatest extent possible and at right angles to framing unless otherwise indicated on Drawings.
2. On partitions/walls, apply gypsum panels horizontally (perpendicular to framing) unless otherwise specified or indicated on Drawings or required by fire-resistance-rated assembly, and minimize end joints.

   a. Stagger abutting end joints not less than one framing member in alternate courses of panels.
   b. At stairwells and other high walls, install panels horizontally unless otherwise indicated on Drawings or required by fire-resistance-rated assembly.

3. On Z-shaped furring members, apply gypsum panels vertically (parallel to framing) with no end joints. Locate edge joints over furring members.
4. Fastening Methods: Apply gypsum panels to supports with steel drill screws.

B. Multilayer Application:

1. On ceilings, apply gypsum board indicated for base layers before applying base layers on walls/partitions; apply face layers in same sequence. Apply base layers at right angles to framing members and offset face-layer joints one framing member, **16 inches** minimum, from

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parallel base-layer joints, unless otherwise indicated on Drawings or required by fire-resistance-rated assembly.

2. On partitions/walls, apply gypsum board indicated for base layers and face layers vertically (parallel to framing) with joints of base layers located over studs or furring members and face-layer joints offset at least one stud or furring member with base-layer joints unless otherwise indicated on Drawings or required by fire-resistance-rated assembly. Stagger joints on opposite sides of partitions.
3. On Z-shaped furring members, apply base layer vertically (parallel to framing) and face layer either vertically (parallel to framing) or horizontally (perpendicular to framing) with vertical joints offset at least one furring member. Locate edge joints of base layer over furring members.
4. Fastening Methods: Fasten base layers and face layers separately to supports with screws.

C. Application of Laminating Adhesive to Substrate: Where gypsum panels are indicated as directly adhered to a substrate (other than studs, joists, furring members, or base layer of gypsum board), comply with gypsum board manufacturer's written instructions and temporarily brace or fasten gypsum panels until fastening adhesive has set.

D. Curved Surfaces:

1. Install panels horizontally (perpendicular to supports) and unbroken, to extent possible, across curved surface plus **12-inch-** long straight sections at ends of curves and tangent to them.
2. For double-layer construction, fasten base layer to studs with screws **16 inches** o.c. Center gypsum board face layer over joints in base layer, and fasten to studs with screws spaced **12 inches** o.c.

E. Trim for Interior Gypsum Board: For trim with back flanges intended for fasteners, attach to framing with same fasteners used for panels. Otherwise, attach trim in accordance with manufacturer's written instructions.

1. Cornerbead: Install at outside corners unless otherwise specified or indicated on Drawings.
2. Bullnose Bead: Install where indicated on Drawings.
3. LC-Bead: Install at exposed panel edges.
4. L-Bead: Install where indicated on Drawings.
5. U-Bead: Install at exposed panel edges.
6. Curved-Edge Cornerbead: Install at curved openings.
7. Expansion (Control) Joint: Install control joints in accordance with ASTM C840 and in specific locations approved by Architect for visual effect.

F. Base-of-Wall PVC Moisture Barrier Trim: Install at base of wall unless otherwise specified or indicated on Drawings.

G. Joint Treatment Materials for Interior Gypsum Board: Treat joints, interior angles, edge trim, control joints, penetrations, fastener heads, surface defects, and elsewhere as required to prepare panel surfaces for decoration. Promptly remove residual joint compound from adjacent surfaces.

1. Prefill open joints and damaged surface areas.
2. Apply joint tape over panel joints, except for trim products specifically indicated as not intended to receive tape.

H. Finish interior gypsum board panels to comply with levels indicated below and in accordance with ASTM C840:

1. Level 1: Ceiling plenum areas, concealed areas, and where indicated on Drawings.
2. Level 2: Panels that are substrate for tile.
3. Level 3: Where indicated on Drawings.

   a. Primer and its application to surfaces are specified in Section 099123 "Interior Painting."

4. Level 4: At panel surfaces that will be exposed to view unless otherwise indicated.

   a. Primer and its application to surfaces are specified in Section 099123 "Interior Painting."

5. Level 5: Where indicated on Drawings.

   a. Primer and its application to surfaces are specified in Section 099123 "Interior Painting."

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3.4 INSTALLATION OF EXTERIOR GYPSUM BOARD

A. Apply panels perpendicular to supports, with end joints staggered and located over supports.

1. Install with **1/4-inch** open space where panels abut other construction or structural penetrations.
2. Fasten with corrosion-resistant screws.

B. Trim for Exterior Gypsum Board: Install in the following locations:

1. Cornerbead: Use at outside corners.
2. LC-Bead: Use at exposed panel edges.
3. Expansion (Control) Joint: Install control joints in accordance with ASTM C840 and in specific locations approved by Architect for visual effect.

C. Finish exterior gypsum board in accordance with manufacturer's written instructions.

3.5 INSTALLATION OF TILE BACKING PANELS

A. Glass-Mat, Water-Resistant Gypsum Panel: Comply with manufacturer's written installation instructions and install at locations indicated to receive tile. Install with **1/4-inch** gap where panels abut other construction or penetrations.

B. Coated Glass-Mat, Water-Resistant Gypsum Backing Panel: Comply with manufacturer's written installation instructions and install at locations indicated to receive tile. Install with **1/4-inch** gap where panels abut other construction or penetrations.

C. Water-Resistant Gypsum Backing Board: Install where indicated with **1/4-inch** gap where panels abut other construction or penetrations.

D. Where tile backing panels abut other types of panels in same plane, shim surfaces to produce a uniform plane across panel surfaces.

E. Finish tile backing panels in accordance with manufacturer's written instructions.

3.6 PROTECTION

A. Protect adjacent surfaces from joint compound and promptly remove from floors and other non-gypsum board surfaces. Repair surfaces stained, marred, or otherwise damaged during gypsum board installation and finishing.

B. Protect installed products from damage from weather, condensation, direct sunlight, construction, and other causes during remainder of the construction period.

C. Remove and replace panels that have gotten wet, moisture damaged, or mold damaged.

1. Indications that panels are wet or moisture damaged include, but are not limited to, discoloration, sagging, or irregular shape.
2. Indications that panels are mold damaged include, but are not limited to, fuzzy or splotchy surface contamination and discoloration.

END OF SECTION 09 29 00

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SECTION 09 30 13 - CERAMIC TILING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Porcelain tiles.
2. Waterproof membranes.
3. Crack isolation membranes.
4. Setting materials.
5. Grout materials.
6. Metal edge trim.

B. Related Requirements:

1. Section 079200 "Joint Sealants" for sealing of movement joints in tile surfaces.
2. Section 092900 "Gypsum Board" for tile backing panels.

1.2 DEFINITIONS

A. General: Definitions in ANSI A108 series of tile installation standards and in ANSI A137.1 apply to Work of this Section unless otherwise specified.

B. Face Size: Actual tile size, excluding spacer lugs.

C. Large Format Tile: Tile with at least one edge **15 inches** or longer.

D. Module Size: Actual tile size plus joint width indicated.

1.3 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1. Review requirements in ANSI A108.01 for substrates and for preparation by other trades.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of specified product.

B. Samples for Initial Selection: For tile, grout, and accessories involving color selection or shade variation.

C. Samples for Verification:

1. Full-size units of each type and composition of tile and for each color and finish required. For ceramic mosaic tile in color blend patterns, provide full sheets of each color blend.
2. Assembled samples mounted on a rigid panel, with grouted joints, for each type and composition of tile and for each color and finish required. Make samples at least 12 inches square, but not fewer than four tiles. Use grout of type and in color or colors approved for completed Work.
3. Full-size units of each type of trim and accessory for each color and finish required.
4. Stone thresholds in **6-inch** lengths.
5. Metal flooring transitions **6-inch** lengths.

1.5 INFORMATIONAL SUBMITTALS

A. Master Grade Certificates: For each shipment, type, and composition of tile, signed by tile manufacturer and Installer.

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B. Product Certificates: For each type of product, including product use classification.

C. Product Test Reports:

1. Tile-setting and -grouting products.
2. Certified porcelain tile.

D. Slip-Resistance Test Reports: For each type of floor tile, from a qualified independent testing agency.

E. Field Quality Control Reports: Water test reports of membrane in wet areas.

F. Qualification Statements: For Installer.

1.6 MAINTENANCE MATERIAL SUBMITTALS

A. Extra Stock Material: Furnish extra materials, from the same production run, to Owner that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Tile and Trim Units: Furnish quantity of full-size units equal to 5 percent of amount installed for each type, composition, color, pattern, and size specified.
2. Grout: Furnish quantity of grout equal to 3 percent of amount installed for each type, composition, and color indicated for Project.

1.7 QUALITY ASSURANCE

A. Installer Qualifications:

1. Installer's supervisor for Project holds the International Masonry Institute's Supervisor Certification.
2. Installer employs only Ceramic Tile Education Foundation Certified Installers or installers recognized by the U.S. Department of Labor as Journeyman Tile Layers for Project.

1.8 MOCKUPS

A. Build mockups to verify selections made under Sample submittals, to demonstrate aesthetic effects, and to set quality standards for materials and execution.

1. Build mockup of each type of floor tile installation.
2. Build mockup of each type of wall tile installation.
3. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Owner specifically approves such deviations by Change Order.
4. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.9 DELIVERY, STORAGE, AND HANDLING

A. Deliver and store packaged materials in original containers with seals unbroken and labels intact until time of use. Comply with requirements in ANSI A137.1 for labeling tile packages.

B. Store tile and cementitious materials on elevated platforms, under cover, and in a dry location.

C. Store aggregates where grading and other required characteristics can be maintained and contamination can be avoided.

D. Store liquid materials in unopened containers and protected from freezing.

1.10 FIELD CONDITIONS

A. Environmental Limitations: Do not install tile until construction in spaces is complete and ambient temperature and humidity conditions are maintained at the levels indicated in referenced standards and manufacturer's written instructions.

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1.11 WARRANTY

A. System Warranty: Manufacturer's non-prorated comprehensive warranty that agrees to repair and replace defective installation areas, material, and labor that fail under normal usage within specified warranty period.

1. Warranty Period: 10 years from date of Product Purchase.

PART 2 - PRODUCTS

2.1 SOURCE LIMITATIONS

A. Tile: Obtain tile of each type and color or finish from single source or producer.

1. Obtain tile of each type and color or finish from same production run and of consistent quality in appearance and physical properties for each contiguous area.

B. Tiling System: Obtain system products from single manufacturer and each aggregate from single source or producer.

1. Basis-of-Design Product: Subject to compliance with requirements, provide (TL-01, TL-02, etc.) Manufacturer: See Materials Schedule on the drawings or comparable product by one of the following:

   a. ARDEX Americas
   b. Custom Building Products
   c. Laticrete International, Inc.
   d. MAPEI Corporation

2. Obtain setting and grouting materials, except for unmodified portland cement and aggregate, from single manufacturer.
3. Obtain underlayment from manufacturer of setting and grouting materials.
4. Obtain waterproof membrane, crack isolation, and other required membranes from manufacturer of setting and grouting materials.
5. Obtain joint sealants from manufacturer of setting and grouting materials.

C. Accessory Products: Obtain each of the following products specified in this Section from a single manufacturer:

1. Stone thresholds.
2. Backer units.

2.2 CERAMIC TILE SYSTEM, GENERAL

A. ANSI Ceramic Tile Standard: Provide tile that complies with ANSI A137.1 for types, compositions, and other characteristics indicated.

1. Provide tile complying with Standard Grade requirements unless otherwise indicated.

B. ANSI Standards for Tile Installation Materials: Provide materials complying with ANSI A108.02, ANSI standards referenced in other Part 2 articles, ANSI standards referenced by TCNA installation methods specified in tile installation schedules, and other requirements specified.

C. Factory Blending: For tile exhibiting color variations within ranges, blend tile in factory and package so tile units taken from one package show same range in colors as those taken from other packages and match approved Samples.

D. Mounting: For factory-mounted tile, provide back- or edge-mounted tile assemblies as standard with manufacturer unless otherwise indicated.

1. Where tile is indicated for installation on exteriors, do not use back- or edge-mounted tile assemblies unless tile manufacturer specifies in writing that this type of mounting is suitable for installation indicated and has a record of successful in-service performance.

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E. Factory-Applied Temporary Protective Coating: Where indicated under tile type, protect exposed surfaces of tile against adherence of mortar and grout by precoating with continuous film of petroleum paraffin wax, applied hot. Do not coat unexposed tile surfaces.

2.3 PORCELAIN TILES

A. Porcelain Tile:

1. Basis-of-Design Product: Subject to compliance with requirements, provide (TL-01, TL-02, etc.) Manufacturer: See Materials Schedule on the drawings or comparable product by one of the following:

   a. American Olean; a brand of Dal-Tile Corporation
   b. Crossville, Inc.
   c. Daltile; a brand of Dal-Tile Corporation
   d. Florida Tile, Inc.
   e. Florim USA
   f. Interceramic
   g. Iris Ceramics U.S., a division of Stonepeak Ceramics, Inc.
   h. Marazzi USA; a brand of Dal-Tile Corporation
   i. Portobello America, Inc.
   j. Vitromex USA, Inc.

2. Certification: Tile certified by the Porcelain Tile Certification Agency.
3. Face Size: As indicated on drawings.
4. Face Size Variation: Rectified.
5. Thickness: 3/8 inch.
6. Tile Color, Glaze, and Pattern: As indicated by manufacturer's designations.
7. Grout Color: As indicated by manufacturer's designations.
8. Precoat with temporary protective coating.
9. Trim Units: Coordinated with sizes and coursing of adjoining flat tile where applicable and matching characteristics of adjoining flat tile. Provide shapes as follows, selected from manufacturer's standard shapes:

2.4 WATERPROOF MEMBRANES

A. General: Manufacturer's standard product that complies with ANSI A118.10 and is recommended in writing by manufacturer for application indicated. Include reinforcement and accessories recommended in writing by manufacturer.

B. Waterproof Membrane, Sheet: Polyethylene sheet faced on one or both sides with polyester fabric.

1. Nominal Thickness: 0.02 inch.

2.5 CRACK ISOLATION MEMBRANES

A. General: Manufacturer's standard product that complies with ANSI A118.12 for high performance and is recommended in writing by manufacturer for application indicated. Include reinforcement and accessories recommended in writing by manufacturer.

B. Crack Isolation Membrane, Polyethylene Sheet: Polyethylene faced on both sides with polyester fabric.

2.6 SETTING MATERIALS

A. Portland Cement Mortar (Thickset) : ANSI A108.02.

1. Cleavage Membrane: Installer's option of material that complies with ANSI A108.02, paragraph 3.8.
2. Latex Additive: Manufacturer's standard water emulsion, serving as replacement for part or all of gaging water, of type specifically recommended in writing by latex-additive manufacturer for use with field-mixed portland cement and aggregate mortar bed.

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B. Standard Dry-Set Mortar (Thinset): ANSI A118.1.

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. ARDEX Americas
   b. Boiardi Products Corporation; a QEP company
   c. Bostik; Arkema
   d. C-Cure
   e. Custom Building Products
   f. H.B. Fuller Construction Products Inc. / TEC
   g. Laticrete International, Inc.
   h. MAPEI Corporation
   i. Parex, a Sika brand
   j. Proflex USA
   k. Siena Tile & Stone Installation Products; Omega Products International
   l. Southern Grouts & Mortars, Inc
   m. Summitville Tiles, Inc.

2. For wall applications, provide mortar that complies with requirements for nonsagging mortar in addition to other requirements in ANSI A118.1.

2.7 GROUT MATERIALS

A. Standard Cement Grout: ANSI A118.6.

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. ARDEX Americas
   b. Boiardi Products Corporation; a QEP company
   c. Bostik; Arkema
   d. C-Cure
   e. Custom Building Products
   f. H.B. Fuller Construction Products Inc. / TEC
   g. Laticrete International, Inc.
   h. MAPEI Corporation
   i. Parex, a Sika brand
   j. Sakrete; CRH Americas, Oldcastle APG
   k. Siena Tile & Stone Installation Products; Omega Products International
   l. Sika Corporation
   m. Southern Grouts & Mortars, Inc
   n. Summitville Tiles, Inc.

B. Water-Cleanable Epoxy Grout: ANSI A118.3.

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. ARDEX Americas
   b. Boiardi Products Corporation; a QEP company
   c. Bostik; Arkema
   d. C-Cure
   e. Custom Building Products
   f. H.B. Fuller Construction Products Inc. / TEC
   g. Laticrete International, Inc.
   h. MAPEI Corporation
   i. Parex, a Sika brand
   j. Sika Corporation
   k. Southern Grouts & Mortars, Inc
   l. Summitville Tiles, Inc.

2. Maximum VOC Content: 65 g/L or less.
3. Provide product capable of withstanding continuous and intermittent exposure to temperatures

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of up to **140 and 212 deg F**, respectively, and certified by manufacturer for intended use.

2.8 MISCELLANEOUS MATERIALS

A. Trowelable Underlayments and Patching Compounds : Latex-modified, portland cement-based formulation provided or approved by manufacturer of tile-setting and adhesive materials for installations indicated.

B. Metal Edge Trim: Profile designed for wall terminations and edge protection.

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. Blanke Corporation
   b. Dural USA, Inc.
   c. Profilitec Corp.
   d. Progress Profiles America Inc.
   e. Schluter Systems L.P.

2. Profile: As indicated on drawings.
3. Material and Finish: Polished nickel anodized aluminum exposed-edge material.

C. Grout Sealer : Grout manufacturer's standard product for sealing grout joints that does not change color or appearance of grout.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions where tile will be installed, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.

1. Verify that substrates for setting tile are firm; dry; clean; free of coatings that are incompatible with tile-setting materials, including curing compounds and other substances that contain soap, wax, oil, or silicone; and comply with flatness tolerances required by ANSI A108.01 for installations indicated.
2. Verify that concrete substrates for tile floors installed with adhesives or thinset mortar comply with surface finish requirements in ANSI A108.01 for installations indicated.

   a. Verify that surfaces that received a steel trowel finish have been mechanically scarified.
   b. Verify that protrusions, bumps, and ridges have been removed by sanding or grinding.

3. Verify that installation of grounds, anchors, recessed frames, electrical and mechanical units of work, and similar items located in or behind tile has been completed.
4. Verify that joints and cracks in tile substrates are coordinated with tile joint locations; if not coordinated, adjust joint locations in consultation with Architect.

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

3.2 PREPARATION

A. Remove coatings, including curing compounds or other coatings, that are incompatible with tile-setting materials.

B. Fill cracks, holes, and depressions in concrete substrates for tile floors installed with adhesives or with trowelable leveling and patching compound specifically recommended in writing by tile-setting material manufacturer.

C. Where indicated, prepare substrates to receive waterproof membrane by applying a reinforced mortar bed that complies with ANSI A108.1 and is sloped **1/4 inch per foot** toward drains.

D. Blending: For tile exhibiting color variations, verify that tile has been factory blended and packaged so

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tile units taken from one package show same range of colors as those taken from other packages and match approved Samples. If not factory blended, either return to manufacturer or blend tiles at Project site before installing.

E. Substrate Flatness:

1. For tile shorter than **15 inches**, confirm that structure or substrate is limited to variation of **1/4 inch in 10 ft.** from the required plane, and no more than **1/16 inch in 12 inches** when measured from tile surface high points.
2. For large format tile, tile with at least one edge **15 inches** or longer, confirm that structure or substrate is limited to **1/8 inch in 10 ft.** from the required plane, and no more than **1/16 inch in 24 inches** when measured from tile surface high points.

F. Field-Applied Temporary Protective Coating: If indicated under tile type or needed to prevent grout from staining or adhering to exposed tile surfaces, precoat them with continuous film of temporary protective coating, taking care not to coat unexposed tile surfaces.

3.3 INSTALLATION OF CERAMIC TILE SYSTEM, GENERAL

A. Tile Backing Panels: Install backing panels and treat joints in accordance with ANSI A108.11 and manufacturer's written instructions for type of application indicated.

B. Waterproof Membranes: Install waterproof membrane to comply with ANSI A108.13 and manufacturer's written instructions to produce waterproof membrane of uniform thickness that is bonded securely to substrate.

1. Allow waterproof membrane to cure and verify by testing that it is watertight before installing tile or setting materials over it.

C. Crack Isolation Membranes: Install crack isolation membrane to comply with ANSI A108.17 and manufacturer's written instructions to produce membrane of uniform thickness that is bonded securely to substrate.

1. Allow crack isolation membrane to cure before installing tile or setting materials over it.

D. Setting and Grout Materials: Mix mortars and grouts to comply with referenced standards and mortar and grout manufacturers' written instructions.

1. Add materials, water, and additives in accurate proportions.
2. Obtain and use type of mixing equipment, mixer speeds, mixing containers, mixing time, and other procedures to produce mortars and grouts of uniform quality with optimum performance characteristics for installations indicated.

E. Install tile in accordance with TCNA's "Handbook for Ceramic, Glass, and Stone Tile Installation" for TCNA installation methods specified in tile installation schedules. Comply with parts of ANSI A108 series that are referenced in TCNA installation methods and specified in tile installation schedules, and apply to types of setting and grouting materials used.

1. For the following installations, follow procedures in ANSI A108 series of tile installation standards for providing 95 percent mortar coverage:

   a. Exterior tile floors and walls.
   b. Tile floors in wet areas.
   c. Tile swimming pool decks.
   d. Tile floors in laundries.
   e. Tile floors consisting of tiles **8 by 8 inches** or larger.
   f. Tile floors consisting of rib-backed tiles.

2. Extend tile work into recesses and under or behind equipment and fixtures to form complete covering without interruptions unless otherwise indicated. Terminate work neatly at obstructions, edges, and corners without disrupting pattern or joint alignments.
3. Accurately form intersections and returns. Perform cutting and drilling of tile without marring visible surfaces. Carefully grind cut edges of tile abutting trim, finish, or built-in items for straight aligned joints. Fit tile closely to electrical outlets, piping, fixtures, and other penetrations so

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plates, collars, or covers overlap tile.

4. Provide manufacturer's standard trim shapes where necessary to eliminate exposed tile edges.
5. Where accent tile differs in thickness from field tile, vary setting-bed thickness so that tiles are flush.
6. Jointing Pattern: Lay tile in grid pattern unless otherwise indicated. Lay out tile work and center tile fields in both directions in each space or on each wall area. Lay out tile work to minimize use of pieces that are less than half of a tile. Provide uniform joint widths unless otherwise indicated.

    a. For tile mounted in sheets, make joints between tile sheets same width as joints within tile sheets, so joints between sheets are not apparent in finished Work.
    b. Where adjoining tiles on floor, base, walls, or trim are specified or indicated to be same size, align joints.
    c. Where tiles are specified or indicated to be whole integer multiples of adjoining tiles on floor, base, walls, or trim, align joints unless otherwise indicated.

7. Lay out tile wainscots to dimensions indicated or to next full tile beyond dimensions indicated.

F. Movement Joints: Provide movement joints and other sealant-filled joints, including control, contraction, and isolation joints, where indicated on Drawings. Form joints during installation of setting materials, mortar beds, and tile. Keep joints free of dirt, debris, and setting materials prior to filling with sealants. Do not saw-cut joints after installing tiles.

1. Where joints occur in concrete substrates, locate joints in tile surfaces directly above them.

G. Metal Wall Trim: Install at locations indicated on Drawings.

H. Grout Sealer: Apply grout sealer to cementitious grout joints in tile floors in accordance with manufacturer's written instructions. As soon as sealer has penetrated grout joints, remove excess sealer and sealer from tile faces by wiping with soft cloth.

3.4 FIELD QUALITY CONTROL

A. Water Test:

1. Test of waterproofing membrane in showers and similar areas to be performed by Installation Contractor before setting tile.

    a. Perform test after 24 hours of waterproof membrane installation.
    b. Insert test plug in drain or waste line.
    c. Fill shower base with water, high enough that the membrane-to-drain connection and floor-to-wall transition can be evaluated, and mark wall.
    d. Check for leaks after 24 hours.

B. Nonconforming Work:

1. Waterproof membrane will be considered defective if water level has dropped.
2. Remove and replace defective components and retest.

3.5 ADJUSTING

A. Remove and replace tile that is damaged or that does not match adjoining tile. Provide new matching units, installed as specified and in a manner to eliminate evidence of replacement.

3.6 CLEANING

A. On completion of placement and grouting, clean all ceramic tile surfaces so they are free of foreign matter.

1. Remove grout residue from tile as soon as possible.
2. Clean grout smears and haze from tile in accordance with tile and grout manufacturer's written instructions. Use only cleaners recommended in writing by tile and grout manufacturers and only after determining that cleaners are safe to use by testing on samples of tile and other

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surfaces to be cleaned. Protect metal surfaces and plumbing fixtures from effects of cleaning. Flush surfaces with clean water before and after cleaning.

3.7 PROTECTION

A. Protect installed tile work with kraft paper or other heavy covering during construction period to prevent staining, damage, and wear. If recommended in writing by tile manufacturer, apply coat of neutral protective cleaner to completed tile walls and floors.

B. Prohibit foot and wheel traffic from tiled floors for at least seven days after grouting is completed.

C. Before final inspection, remove protective coverings and rinse neutral protective cleaner from tile surfaces.

END OF SECTION 09 30 13

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SECTION 09 51 23 - ACOUSTICAL TILE CEILINGS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Suspended acoustical tile ceilings.
2. Metal edge moldings and trim.

B. Products Furnished, but Not Installed, under This Section:

1. Anchors, clips, and other ceiling attachment devices to be cast in concrete.

1.2 ADMINISTRATIVE REQUIREMENTS

A. Delegated Design Professional Services: Engage a qualified delegated design engineering professional to design seismic restraints for ceiling systems.

1.3 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of specified product.

B. Samples for Initial Selection: For components with factory-applied finishes.

C. Samples for Verification: For each component indicated and for each exposed finish required, prepared on Samples of sizes indicated below:

1. Acoustical Tiles: Set of full-size Samples of each type, color, pattern, and texture.
2. Concealed Suspension-System Members: 6-inch- long Sample of each type.
3. Exposed Moldings and Trim: Set of 6-inch- long Samples of each type and color.
4. Seismic Clips: Full size.

D. Delegated Design Submittals: For seismic restraints for ceiling systems.

1. Include design calculations for seismic restraints including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

1.5 INFORMATIONAL SUBMITTALS

A. Product Test Reports: For each acoustical tile ceiling, for tests performed by a qualified testing agency.

B. Evaluation Reports: For each acoustical tile ceiling suspension system and anchor and fastener type, from ICC-ES.

C. Field Quality Control Reports: For specified tests and inspections.

1.6 CLOSEOUT SUBMITTALS

A. Maintenance Data: For finishes.

1.7 MAINTENANCE MATERIAL SUBMITTALS

A. Extra Stock Material: Furnish extra materials , from the same production run, that match products

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installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Acoustical Tiles: Full-size tiles equal to 2 percent of quantity installed.
2. Metal Suspension System Components: Quantity of each concealed grid and exposed component equal to 2 percent of quantity installed.

1.8 QUALITY ASSURANCE

A. Delegated Design Professional Qualifications: A professional engineer who is legally qualified to practice in state where Project is located and who is experienced in providing engineering services of the type indicated.

B. Testing Agency Qualifications: An independent agency qualified to perform specified field tests and who is acceptable to authorities having jurisdiction.

C. Special Inspector Qualifications: An independent inspector qualified to perform specified field inspections and who is acceptable to authorities having jurisdiction.

1.9 MOCKUPS

A. Build mockups to verify selections made under Sample submittals, to demonstrate aesthetic effects, and to set quality standards for materials and execution.

1. Build mockup of typical ceiling area as indicated on Drawings.
2. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Owner specifically approves such deviations by Change Order.
3. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.10 DELIVERY, STORAGE, AND HANDLING

A. Deliver acoustical tiles, suspension-system components, and accessories to Project site and store them in a fully enclosed, conditioned space where they will be protected against damage from moisture, humidity, temperature extremes, direct sunlight, surface contamination, and other causes.

B. Before installing acoustical tiles, permit them to reach room temperature and a stabilized moisture content.

1.11 FIELD CONDITIONS

A. Environmental Limitations: Do not install acoustical tile ceilings until spaces are enclosed and weathertight, wet-work in spaces is complete and dry, work above ceilings is complete, and ambient temperature and humidity conditions are maintained at the levels indicated for Project when occupied for its intended use.

1. Pressurized Plenums: Operate ventilation system for not less than 48 hours before beginning acoustical tile ceiling installation.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Surface-Burning Characteristics: Comply with ASTM E84; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.

1. Flame-Spread Index: Class A in accordance with ASTM E1264.
2. Smoke-Developed Index: 450 or less.

B. Fire-Resistance Ratings: Comply with ASTM E119; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.

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1. Indicate design designations from UL or from the listings of another qualified testing agency.

2.2 SUSPENDED ACOUSTICAL TILE CEILINGS

A. Source Limitations: Obtain each type of acoustical ceiling tile and its suspension system from single source from single manufacturer.

B. Seismic Performance: Suspended ceilings to withstand the effects of earthquake motions determined in accordance with ASCE/SEI 7.

C. Suspended Acoustical Tile Ceiling (ACT-01, ACT-02):

1. Basis-of-Design Product: Subject to compliance with requirements, provide As indicated on the drawings or comparable product by one of the following:

   a. Armstrong World Industries
   b. CertainTeed; Saint-Gobain North America
   c. Rockfon; ROCKWOOL International
   d. USG Corporation

2. Acoustical Tiles: Provide manufacturer's standard tiles of configuration indicated that comply with ASTM E1264 classifications as designated by type, form, pattern, acoustical rating, and light reflectance unless otherwise indicated.
3. Recycled Content: Provide manufacturer documentation for recycled content, indicating postconsumer and preconsumer recycled content.
4. Metal Suspension System: Provide manufacturer's standard, direct-hung, fully concealed, metal suspension system and accessories of type, structural classification, and finish indicated that complies with applicable requirements in ASTM C635/C635M.

   a. High-Humidity Finish: Where indicated, provide coating tested and classified for "severe environment performance" in accordance with ASTM C635/C635M.
   b. Direct-Hung, Double-Web Suspension System: Main and cross runners roll formed from and capped with cold-rolled steel sheet, prepainted, electrolytically zinc coated, or hot-dip galvanized, **G30** coating designation.

      1) Fire Rating: As indicated on Drawings.
      2) Structural Classification: Intermediate -duty system.
      3) Access: Upward and end pivoted or side pivoted, with initial access openings of size indicated below and located throughout ceiling within each module formed by main and cross runners, with additional access available by progressively removing remaining acoustical tiles.

D. Accessories:

1. Attachment Devices: Size for five times the design load indicated in ASTM C635/C635M, Table 1, "Direct Hung," unless otherwise indicated. Comply with seismic design requirements.

   a. Anchors in Concrete: Anchors of type and material indicated below, with holes or loops for attaching hangers of type indicated and with capability to sustain, without failure, a load equal to five times that imposed by ceiling construction, as determined by testing in accordance with ASTM E488/E488M or ASTM E1512 as applicable, conducted by a qualified testing and inspecting agency.

      1) Corrosion Protection, Carbon Steel: Components zinc plated in accordance with ASTM B633, Class SC 1 (mild) service condition.
      2) Corrosion Protection, Stainless Steel: Components complying with ASTM F593 and ASTM F594, Group 1 Alloy 304 or 316.

   b. Power-Actuated Fasteners in Concrete: Fastener system of type suitable for application indicated, fabricated from corrosion-resistant materials, with clips or other accessory devices for attaching hangers of type indicated, and with capability to sustain, without failure, a load equal to 10 times that imposed by ceiling construction, as determined by testing in accordance with ASTM E1190, conducted by a qualified testing and inspecting agency.

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2. Wire Hangers, Braces, and Ties: Provide wires as follows:

    a. Zinc-Coated, Carbon-Steel Wire: ASTM A641/A641M, Class 1 zinc coating, soft temper.
    b. Stainless Steel Wire: ASTM A580/A580M, Type 304, nonmagnetic.
    c. Size: Wire diameter sufficient for its stress at three times hanger design load (ASTM C635/C635M, Table 1, "Direct Hung") will be less than yield stress of wire, but not less than 0.106-inch- diameter wire.

3. Hanger Rods: Mild steel, zinc coated or protected with rust-inhibitive paint.
4. Flat Hangers: Mild steel, zinc coated or protected with rust-inhibitive paint.
5. Angle Hangers: Angles with legs not less than **7/8 inch** wide; formed with **0.04-inch-** thick, galvanized-steel sheet complying with ASTM A653/A653M, **G90** coating designation; with bolted connections and **5/16-inch-** diameter bolts.
6. Seismic Stabilizer Bars: Manufacturer's standard perimeter stabilizers designed to accommodate seismic forces.
7. Seismic Struts: Manufacturer's standard compression struts designed to accommodate lateral forces.
8. Seismic Clips: Manufacturer's standard seismic clips designed to secure acoustical tiles in-place during a seismic event.

2.3 METAL EDGE MOLDINGS AND TRIM TYPES

A. Metal Edge Moldings and Trim:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

    a. CertainTeed; Saint-Gobain North America
    b. Rockfon; ROCKWOOL International
    c. USG Corporation

2. Roll-Formed, Sheet-Metal Edge Moldings and Trim: Type and profile indicated or, if not indicated, manufacturer's standard moldings for edges and penetrations complying with seismic design requirements; formed from sheet metal of same material, finish, and color as that used for of suspension-system runners.

    a. Edge moldings to fit acoustical panel edge details and suspension systems indicated and match width and configuration of exposed runners unless otherwise indicated.
    b. For lay-in panels with reveal edge details, provide stepped edge molding that forms reveal of same depth and width as that formed between edge of panel and flange at exposed suspension member.
    c. For circular penetrations of ceiling, provide edge moldings fabricated to diameter required to fit penetration exactly.
    d. Finish: Painted in color as selected from manufacturer's full range.

3. Extruded-Aluminum Edge Moldings and Trim: Where indicated, provide manufacturer's extruded-aluminum edge moldings and trim of profile indicated or referenced by manufacturer's designations, including splice plates, corner pieces, and attachment and other clips, complying with seismic design requirements.

    a. Clear Anodic Finish: AAMA 611, AA-M12C22A31, Class II, 0.010 mm or thicker.
    b. Baked-Enamel or Powder-Coat Finish: Minimum dry film thickness of **1.5 mils**. Comply with ASTM C635/C635M and coating manufacturer's written instructions for cleaning, conversion coating, and applying and baking finish.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions, including structural framing and substrates to which acoustical tile ceilings attach or abut, with Installer present, for compliance with requirements specified in this and other Sections that affect ceiling installation and anchorage and for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.

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B. Examine acoustical tiles before installation. Reject acoustical tiles that are wet, moisture damaged, or mold damaged.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Testing Substrates: Before adhesively bonding tiles to wet-placed substrates such as cast-in-place concrete or plaster, test and verify that moisture level is below tile manufacturer's written recommended limits.

B. Measure each ceiling area and establish layout of acoustical tiles to balance border widths at opposite edges of each ceiling. Avoid using less-than-half-width tiles at borders unless otherwise indicated, and comply with layout shown on reflected ceiling plans.

C. Layout openings for penetrations centered on the penetrating items.

3.3 INSTALLATION OF SUSPENDED ACOUSTICAL TILE CEILINGS

A. Install suspended acoustical tile ceilings in accordance with ASTM C636/C636M , seismic design requirements, and manufacturer's written instructions.

1. Fire-Rated Assembly: Install fire-rated ceiling systems in accordance with tested fire-rated design.

B. Suspend ceiling hangers from building's structural members and as follows:

1. Install hangers plumb and free from contact with insulation or other objects within ceiling plenum that are not part of supporting structure or of ceiling suspension system.
2. Splay hangers only where required and, if permitted with fire-resistance-rated ceilings, to miss obstructions; offset resulting horizontal forces by bracing, countersplaying, or other equally effective means.
3. Where width of ducts and other construction within ceiling plenum produces hanger spacings that interfere with location of hangers at spacings required to support standard suspension-system members, install supplemental suspension members and hangers in form of trapezes or equivalent devices.
4. Secure wire hangers to ceiling suspension members and to supports above with a minimum of three tight turns. Connect hangers directly to structure or to inserts, eye screws, or other devices that are secure and appropriate for substrate and that will not deteriorate or otherwise fail due to age, corrosion, or elevated temperatures.
5. Secure flat, angle, channel, and rod hangers to structure, including intermediate framing members, by attaching to inserts, eye screws, or other devices that are secure and appropriate for both the structure to which hangers are attached and the type of hanger involved. Install hangers in a manner that will not cause them to deteriorate or fail due to age, corrosion, or elevated temperatures.
6. Do not support ceilings directly from permanent metal forms or floor deck. Fasten hangers to cast-in-place hanger inserts, postinstalled mechanical or adhesive anchors, or power-actuated fasteners that extend through forms into concrete.
7. When steel framing does not permit installation of hanger wires at spacing required, install carrying channels or other supplemental support for attachment of hanger wires.
8. Do not attach hangers to steel deck tabs.
9. Do not attach hangers to steel roof deck. Attach hangers to structural members.
10. Space hangers not more than **48 inches** o.c. along each member supported directly from hangers unless otherwise indicated; provide hangers not more than **8 inches** from ends of each member.
11. Size supplemental suspension members and hangers to support ceiling loads within performance limits established by referenced standards.

C. Secure bracing wires to ceiling suspension members and to supports with a minimum of four tight turns. Suspend bracing from building's structural members as required for hangers without attaching to permanent metal forms, steel deck, or steel deck tabs. Fasten bracing wires into concrete with cast-in-place or postinstalled anchors.

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D. Metal Edge Moldings and Trim: Install edge moldings and trim of type indicated at perimeter of acoustical ceiling area and where necessary to conceal edges of acoustical tiles.

1. Screw attach moldings to substrate at intervals not more than **16 inches** o.c. and not more than **3 inches** from ends. Miter corners accurately and connect securely.
2. Do not use exposed fasteners, including pop rivets, on moldings and trim.

E. Install suspension-system runners so they are square and securely interlocked with one another. Remove and replace dented, bent, or kinked members.

F. Arrange directionally patterned acoustical tiles as follows:

1. As indicated on reflected ceiling plans.

G. Install acoustical tiles in coordination with suspension system and exposed moldings and trim. Place splines or suspension-system flanges into kerfed edges of tiles so tile-to-tile joints are interlocked.

1. Fit adjoining tiles to form flush, tight joints. Scribe and cut tiles for accurate fit at borders and around penetrations through ceiling.
2. Hold tile field in compression by inserting leaf-type, spring-steel spacers between tiles and moldings, spaced **12 inches** o.c.
3. Protect lighting fixtures and air ducts in accordance with requirements indicated for fire-resistance-rated assembly.

3.4 ERECTION TOLERANCES

A. Suspended Acoustical Tile Ceilings: Install main and cross runners level to a tolerance of 1/8 inch in 12 feet, non-cumulative.

B. Metal Edge Moldings and Trim: Install moldings and trim to substrate and level with ceiling suspension system to a tolerance of 1/8 inch in 12 feet, non-cumulative.

3.5 FIELD QUALITY CONTROL

A. Special Inspections: Owner will engage a qualified special inspector to perform the following special inspections:

1. Periodic inspection during the installation of suspended ceiling grids in accordance with ASCE/SEI 7.

B. Testing Agency: Owner will engage a qualified testing agency to perform tests and inspections.

C. Tests and Inspections: Perform the following tests and inspections of completed installations of acoustical tile ceiling hangers and anchors and fasteners in successive stages and when installation of ceiling suspension systems on each floor has reached 20 percent completion, but no tiles have been installed. Do not proceed with installations of acoustical tile ceiling hangers for the next area until test results for previously completed installations of acoustical tile ceiling hangers show compliance with requirements.

1. Within each test area, testing agency will select one of every 10 power-actuated fasteners and postinstalled anchors used to attach hangers to concrete and will test them for **200 lbf** of tension; it will also select one of every two postinstalled anchors used to attach bracing wires to concrete and will test them for **440 lbf** of tension.
2. When testing discovers fasteners and anchors that do not comply with requirements, testing agency will test those anchors not previously tested until 20 pass consecutively and then will resume initial testing frequency.

D. Acoustical tile ceiling hangers, anchors, and fasteners will be considered defective if they do not pass tests and inspections.

E. Prepare test and inspection reports.

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3.6 CLEANING

A. Clean exposed surfaces of acoustical tile ceilings, including trim and edge moldings. Comply with manufacturer's written instructions for cleaning and touchup of minor finish damage.

B. Remove and replace tiles and other ceiling components that cannot be successfully cleaned and repaired to permanently eliminate evidence of damage.

END OF SECTION 09 51 23

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SECTION 09 65 13 - RESILIENT BASE AND ACCESSORIES

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Vinyl base.
2. Vinyl stair treads.
3. Rubber molding accessories.
4. Vinyl molding accessories.

B. Related Requirements:

1. Section 024119 "Selective Demolition" for removing existing floor coverings.
2. Section 096519 "Resilient Tile and Plank Flooring" for modular resilient flooring.
3. Section 096813 "Tile Carpeting" for modular carpet tile flooring.

1.2 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1. Review methods and procedures related to resilient base and accessory installation including, but not limited to, the following:

   a. Delivery, storage, and handling procedures.
   b. Ambient conditions and ventilation procedures.
   c. Subfloor preparation procedures for resilient stair accessories.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of specified product.

1. Include manufacturer's written data on physical characteristics, durability, and fade resistance.
2. Include manufacturer's written installation instructions for each type of substrate.

B. Samples: For each exposed product and for each color and texture specified, not less than **12 inches** long.

C. Samples for Initial Selection: For each type of exposed product.

D. Samples for Verification: For each type of exposed product indicated and for each color, texture, and pattern required in manufacturer's standard-size Samples, but not less than **12 inches** long.

E. Product Schedule: For resilient base and accessory products. Use same designations indicated on Drawings.

1.4 INFORMATIONAL SUBMITTALS

A. Product Test Reports: For resilient base and accessory products, for tests performed by a qualified testing agency.

1.5 MAINTENANCE MATERIAL SUBMITTALS

A. Extra Stock Material: Furnish extra materials , from the same production run, to Owner that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Furnish not less than 10 linear ft. for every 500 linear ft. or fraction thereof, of each type, color, pattern, and size of resilient product installed.

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1.6 MOCKUPS

A. Build mockups to verify selections made under Sample submittals, to demonstrate aesthetic effects, and to set quality standards for materials and execution.

1. Coordinate mockups in this Section with mockups specified in other Sections.
2. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Owner specifically approves such deviations by Change Order.
3. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Store resilient products and installation materials in dry spaces protected from the weather, with ambient temperatures maintained within range recommended by manufacturer, but not less than **50 deg F** or more than **90 deg F**.

1.8 FIELD CONDITIONS

A. Installation Temperature Requirements: Maintain ambient temperatures within range recommended by manufacturer, but not less than 70 deg F or more than 95 deg F, in spaces to receive resilient products during the following periods:

1. 48 hours before installation.
2. During installation.
3. 48 hours after installation.

B. Post-Installation Temperature Requirements: After installation and until Substantial Completion, maintain ambient temperatures within range recommended by manufacturer, but not less than 55 deg F or more than 95 deg F.

C. Install resilient products after other finishing operations, including painting, have been completed.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Fire-Test-Response Characteristics: As determined by testing identical products in accordance with ASTM E648 or ASTM E662 by a qualified testing agency.

1. Critical Radiant Flux Classification: Class I, not less than 0.45 W/sq. cm.

2.2 RESILIENT BASE

A. Recycled Content: Postconsumer recycled content plus one-half of preconsumer recycled content not less than <**Insert number**> percent.

B. Vinyl Base:

1. Basis-of-Design Product: Subject to compliance with requirements, provide As indicated on the drawings or comparable product by one of the following:

   a. Flexco Corporation
   b. Mannington Mills, Inc
   c. Mohawk Group
   d. Roppe Corporation; Roppe Holding Company
   e. Shaw Industries Group, Inc.; Berkshire Hathaway Company
   f. Tarkett USA
   g. VPI Corporation

2. Classification: ASTM F1861, Type TV (vinyl, thermoplastic), Group I (solid, homogeneous) or.
3. Style and Location:

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a. Style A, Straight: Provide in areas with carpet.
b. Style B, Cove: Provide in areas with resilient floor coverings.

4. Minimum Thickness: 0.125 inch.
5. Height: As indicated on Drawings.
6. Lengths: Coils in manufacturer's standard length.
7. Outside Corners: Job formed or preformed.
8. Inside Corners: Job formed or preformed.
9. Colors and Patterns: As indicated by manufacturer's designations.

2.3 RESILIENT STAIR ACCESSORIES

A. Recycled Content: Postconsumer recycled content plus one-half of preconsumer recycled content not less than <**Insert number**> percent.

B. Vinyl Stair Treads:

1. Basis-of-Design Product: Subject to compliance with requirements, provide As indicated on the drawigns or comparable product by one of the following:

a. Flexco Corporation
b. Roppe Corporation; Roppe Holding Company
c. Tarkett USA
d. VPI Corporation

2. Classification: ASTM F2169, Type TV (vinyl, thermoplastic).

a. Class: 1 (smooth, flat).
b. Group: 1 (embedded abrasive strips).

3. Nosing Style: Square, adjustable to cover angles between 60 and 90 degrees.
4. Thickness: 1/4 inch and tapered to back edge.
5. Size: Lengths and depths to fit each stair tread in one piece or, for treads exceeding maximum lengths manufactured, in equal-length units.

C. Locations: Provide resilient stair accessories in areas indicated on Drawings.

D. Colors and Patterns: As indicated by manufacturer's designations.

2.4 RESILIENT MOLDING ACCESSORIES

A. Rubber Molding Accessories :

1. Accessory Description: transition strips.
2. Profile and Dimensions: As indicated on Drawings.

B. Vinyl Molding Accessories :

1. Accessory Description: transition strips.
2. Profile and Dimensions: As indicated on Drawings.

C. Locations: Provide resilient molding accessories in areas indicated on Drawings.

D. Colors and Patterns: As indicated by manufacturer's designations.

2.5 INSTALLATION MATERIALS

A. Trowelable Leveling and Patching Compounds: Latex-modified, portland-cement-based or blended hydraulic-cement-based formulation provided or approved by resilient-product manufacturer for applications indicated.

B. Adhesives: Water-resistant type recommended in writing by resilient-product manufacturer for resilient products and substrate conditions indicated.

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C. Stair-Tread Nose Filler: Two-part epoxy compound recommended by resilient stair-tread manufacturer to fill nosing substrates that do not conform to tread contours.

D. Metal Edge Strips: Nominal **2 inches** wide, of height required to protect exposed edges of flooring, and in maximum available lengths to minimize running joints.

1. Material: Extruded aluminum with mill finish.

E. Floor Polish: Provide protective, liquid floor-polish products recommended by resilient stair-tread manufacturer.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, with Installer present, for compliance with requirements for maximum moisture content and other conditions affecting performance of the Work.

1. Verify that finishes of substrates comply with tolerances and other requirements specified in other Sections and that substrates are free of cracks, ridges, depressions, scale, and foreign deposits that might interfere with adhesion of resilient products.

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

1. Installation of resilient products indicates acceptance of surfaces and conditions.

3.2 PREPARATION

A. Prepare substrates in accordance with manufacturer's written instructions to ensure adhesion of resilient products.

B. Concrete Substrates for Resilient Stair Accessories: Prepare horizontal surfaces in accordance with ASTM F710.

1. Verify that substrates are dry and free of curing compounds, sealers, and hardeners.
2. Remove substrate coatings and other substances that are incompatible with adhesives and that contain soap, wax, oil, or silicone, using mechanical methods recommended by manufacturer. Do not use solvents.
3. Alkalinity and Adhesion Testing: Perform tests recommended by manufacturer. Proceed with installation only after substrate alkalinity falls within range on pH scale recommended by manufacturer in writing, but not less than 5 or more than 9 pH.
4. Moisture Testing: Perform tests so that each test area does not exceed 1000 sq. ft., and perform no fewer than three tests in each installation area and with test areas evenly spaced in installation areas.

   a. Anhydrous Calcium Chloride Test: ASTM F1869. Proceed with installation only after substrates have maximum moisture-vapor-emission rate of 3 lb of water/1000 sq. ft. in 24 hours.
   b. Relative Humidity Test: Using in-situ probes, ASTM F2170. Proceed with installation only after substrates have a maximum 75 percent relative humidity level measurement.

C. Fill cracks, holes, and depressions in substrates with trowelable leveling and patching compound; remove bumps and ridges to produce a uniform and smooth substrate.

D. Do not install resilient products until materials are the same temperature as space where they are to be installed.

1. At least 48 hours in advance of installation, move resilient products and installation materials into spaces where they will be installed.

E. Immediately before installation, sweep and vacuum clean substrates to be covered by resilient products.

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3.3 INSTALLATION OF RESILIENT BASE

A. Comply with manufacturer's written instructions for installing resilient base.

B. Apply resilient base to walls, columns, pilasters, casework and cabinets in toe spaces, and other permanent fixtures in rooms and areas where base is required.

C. Install resilient base in lengths as long as practical without gaps at seams and with tops of adjacent pieces aligned.

D. Tightly adhere resilient base to substrate throughout length of each piece, with base in continuous contact with horizontal and vertical substrates.

E. Do not stretch resilient base during installation.

F. On masonry surfaces or other similar irregular substrates, fill voids along top edge of resilient base with manufacturer's recommended adhesive filler material.

G. Preformed Corners: Install preformed corners before installing straight pieces.

H. Job-Formed Corners:

1. Outside Corners: Use straight pieces of maximum lengths possible and form with returns not less than 3 inches in length.

   a. Form without producing discoloration (whitening) at bends.

2. Inside Corners: Use straight pieces of maximum lengths possible and form with returns not less than 3 inches in length.

   a. Miter corners to minimize open joints.

3.4 INSTALLATION OF RESILIENT STAIR ACCESSORIES

A. Comply with manufacturer's written instructions for installing resilient stair accessories.

B. Use stair-tread-nose filler to fill nosing substrates that do not conform to tread contours.

C. Tightly adhere to substrates throughout length of each piece.

D. For treads installed as separate, equal-length units, install to produce a flush joint between units.

3.5 INSTALLATION OF RESILIENT MOLDING ACCESSORIES

A. Comply with manufacturer's written instructions for installing resilient molding accessories.

B. Butt resilient molding accessories to adjacent materials and tightly adhere to substrates throughout length of each piece. Install reducer strips at edges of floor covering that would otherwise be exposed.

3.6 CLEANING

A. Comply with manufacturer's written instructions for cleaning resilient products.

B. Perform the following operations immediately after completing resilient-product installation:

1. Remove adhesive and other blemishes from surfaces.
2. Sweep and vacuum horizontal surfaces thoroughly.
3. Damp-mop horizontal surfaces to remove marks and soil.

C. Floor Polish: Remove soil, adhesive, and blemishes from resilient stair treads before applying liquid floor polish.

1. Apply two coat(s).

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3.7 PROTECTION

A. Comply with manufacturer's written instructions for protecting resilient products.

B. After post-installation cleaning, immediately protect resilient products from mars, marks, indentations, and other damage from construction operations and placement of equipment and fixtures during remainder of construction period.

C. Cover resilient products subject to wear and foot traffic until Substantial Completion.

END OF SECTION 09 65 13

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SECTION 09 65 16 - RESILIENT SHEET FLOORING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Vinyl sheet flooring with backing.

B. Related Requirements:

1. Section 024119 "Selective Demolition" for removing existing floor coverings.
2. Section 096513 "Resilient Base and Accessories" for wall base and accessories installed with resilient sheet flooring.
3. Section 096519 "Resilient Tile and Plank Flooring" for modular resilient flooring.

1.2 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1. Review methods and procedures related to resilient sheet flooring installation including, but not limited to, the following:

a. Delivery, storage, and handling procedures.
b. Ambient conditions and ventilation procedures.
c. Subfloor preparation procedures.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of specified product.

1. Include manufacturer's written data on physical characteristics, durability, and fade resistance.
2. Include manufacturer's written installation instructions for each type of substrate.

B. Shop Drawings: For each type of resilient flooring type required.

1. Include flooring layouts, locations of seams, edges, columns, doorways, enclosing partitions, built-in furniture, cabinets, and cutouts.
2. Show details of special patterns.

C. Samples for Initial Selection: For each type of resilient flooring product required.

D. Samples for Verification: For each type of resilient flooring product, in manufacturer's standard size, but not less than 6-by-9-inch sections of each color, texture, and pattern required.

E. Product Schedule: For each type of resilient flooring product required. Use same designations indicated on Drawings.

1.4 INFORMATIONAL SUBMITTALS

A. Product Test Reports: For resilient sheet flooring, for tests performed by a qualified testing agency.

B. Qualification Statements: For Installer.

1.5 CLOSEOUT SUBMITTALS

A. Maintenance Data: For each type of resilient sheet flooring to include the following:

1. Methods for maintaining resilient sheet flooring, including cleaning and stain-removal products and procedures and manufacturer's recommended maintenance schedule.

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2. Precautions for cleaning materials and methods that could be detrimental to resilient sheet flooring.

1.6 MAINTENANCE MATERIAL SUBMITTALS

A. Extra Stock Material: Furnish extra materials , from the same production run, to Owner that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Resilient Sheet Flooring: Full-width rolls equal to 5 percent of amount installed for each type, color, and pattern indicated, but not less than **10 sq. yd.**.

1.7 QUALITY ASSURANCE

A. Installer Qualifications: An entity that employs installers and supervisors who are competent in techniques required by manufacturer for resilient sheet flooring installation and seaming methods indicated.

1. Engage an installer who employs workers for this Project who are trained or certified by resilient sheet flooring manufacturer for installation techniques required.

1.8 DELIVERY, STORAGE, AND HANDLING

A. Deliver materials in original packages and containers, with seals unbroken, bearing manufacturers' labels indicating brand name and directions for storing.

B. Store resilient sheet flooring and accessory materials in dry spaces protected from the weather, with ambient temperatures maintained within range recommended by manufacturer, but not less than **50 deg F** or more than **90 deg F**. Store rolls upright.

1.9 FIELD CONDITIONS

A. Environmental Limitations: Do not deliver or install resilient flooring until spaces are enclosed and weathertight, wet-work in spaces is complete and dry, and ambient temperature and humidity conditions are maintained at levels planned for building occupants during the remainder of the construction period.

B. Do not install resilient flooring over concrete slabs until slabs have cured and are sufficiently dry to bond with adhesive and concrete slabs have pH range recommended in writing by resilient flooring manufacturer.

C. Adhesively Applied Products:

1. Maintain temperatures during installation within range recommended in writing by manufacturer, but not less than 70 deg F or more than 95 deg F, in spaces to receive flooring 48 hours before installation, during installation, and 48 hours after installation unless longer period is recommended in writing by manufacturer.
2. After postinstallation period, maintain temperatures within range recommended in writing by manufacturer, but not less than 55 deg F or more than 95 deg F.
3. Close spaces to traffic during flooring installation.
4. Close spaces to traffic for 48 hours after flooring installation unless manufacturer recommends longer period in writing.

1.10 WARRANTY

A. Special Warranty for Resilient Flooring Products: Manufacturer agrees to repair or replace components of flooring installation that fail in materials or workmanship within specified warranty period.

1. Warranty does not include deterioration or failure of flooring due to unusual traffic, failure of substrate, vandalism, or abuse.

B. Warranty Period: 10 years from date of Substantial Completion.

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PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Fire-Test-Response Characteristics: For resilient sheet flooring, as determined by testing identical products in accordance with ASTM E648 or ASTM E662 by a qualified testing agency.

1. Critical Radiant Flux Classification: Class I, not less than 0.45 W/sq. cm.

B. Verify flooring products comply with VOC emissions evaluation criteria.

2.2 RESILIENT SHEET FLOORING

A. Vinyl Sheet Flooring with Backing: Resilient sheet flooring product with wear layer that is printed or decorated, composed of fillers, pigments, and vinyl binders with backing.

1. Basis-of-Design Product: Subject to compliance with requirements, provide As indicated on drawings or comparable product by one of the following:

a. Altro
b. Armstrong Flooring, Inc.
c. Forbo Flooring Systems
d. Gerflor USA
e. Mannington Mills, Inc
f. Mohawk Group
g. Roppe Corporation; Roppe Holding Company
h. Shaw Industries Group, Inc.; Berkshire Hathaway Company

2. Classification: ASTM F1303, Type I, minimum binder content of 90 percent, Grade 1.

a. Overall Thickness: Manufacturer's standard.
b. Interlayer Material: Foamed plastic.
c. Backing Class: A (fibrous).

3. Wearing Surface: Smooth.
4. Surface Protection Layer: Clear specialty performance top layer.
5. Sheet Width: Manufacturer's standard.
6. Seamless Installation Method: Heat welded.
7. Colors and Patterns: As indicated by manufacturer's designations.

2.3 INSTALLATION MATERIALS

A. Trowelable Leveling and Patching Compounds: Latex-modified, portland-cement-based or blended hydraulic-cement-based formulation provided or approved by resilient sheet flooring manufacturer for applications indicated.

B. Adhesives: Water-resistant type recommended in writing by flooring and adhesive manufacturers to suit resilient sheet flooring and substrate conditions indicated.

1. Verify adhesive complies with VOC emissions evaluation criteria.

C. Seamless Installation Accessories:

1. Heat-Welding Bead: Manufacturer's solid-strand product for heat welding seams.

a. Colors: Match flooring.

2. Chemical-Bonding Compound: Manufacturer's product for chemically bonding seams.

D. Integral-Flash Cove Base:

1. Cove Strip: **1-inch** radius provided or approved by resilient sheet flooring manufacturer.
2. Cap Strip: Tapered vinyl cap provided or approved by resilient sheet flooring manufacturer.
3. Corners: Metal inside and outside corners and end stops provided or approved by resilient

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sheet flooring manufacturer.

E. Floor Polish: Provide protective, liquid floor-polish products recommended by resilient sheet flooring manufacturer.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, with Installer present, for compliance with requirements for maximum moisture content and other conditions affecting performance of the Work.

1. Verify that finishes of substrates comply with tolerances and other requirements specified in other Sections and that substrates are free of cracks, ridges, depressions, scale, and foreign deposits that might interfere with adhesion of resilient sheet flooring.

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

1. Installation of resilient flooring products indicates acceptance of surfaces and conditions.

3.2 PREPARATION

A. Prepare substrates in accordance with resilient sheet flooring manufacturer's written instructions to ensure adhesion of resilient sheet flooring.

B. Concrete Substrates: Prepare in accordance with ASTM F710.

1. Verify that substrates are dry and free of curing compounds, sealers, and hardeners.
2. Remove substrate coatings and other substances that are incompatible with adhesives and that contain soap, wax, oil, or silicone, using mechanical methods recommended by resilient sheet flooring manufacturer. Do not use solvents.
3. Alkalinity and Adhesion Testing: Perform tests recommended by resilient sheet flooring manufacturer. Proceed with installation only after substrate alkalinity falls within range on pH scale recommended by manufacturer in writing, but not less than 5 or more than 9 pH.
4. Moisture Testing: Perform tests so that each test area does not exceed 1000 sq. ft., and perform no fewer than three tests in each installation area and with test areas evenly spaced in installation areas.

   a. Anhydrous Calcium Chloride Test: ASTM F1869. Proceed with installation only after substrates have maximum moisture-vapor-emission rate of 3 lb of water/1000 sq. ft. in 24 hours.
   b. Relative Humidity Test: Using in-situ probes, ASTM F2170. Proceed with installation only after substrates have a maximum 75 percent relative humidity level measurement.

C. Fill cracks, holes, and depressions in substrates with trowelable leveling and patching compound; remove bumps and ridges to produce a uniform and smooth substrate.

D. Do not install resilient sheet flooring until materials are the same temperature as space where they are to be installed.

1. At least 48 hours in advance of installation, move flooring and installation materials into spaces where they will be installed.

E. Immediately before installation, sweep and vacuum clean substrates to be covered by resilient sheet flooring.

3.3 INSTALLATION OF RESILIENT SHEET FLOORING

A. Comply with manufacturer's written installation instructions.

B. Unroll resilient sheet flooring and allow it to stabilize before cutting and fitting.

C. Lay out resilient sheet flooring as follows:

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1. Maintain uniformity of flooring direction.
2. Minimize number of seams; place seams in inconspicuous and low-traffic areas, at least **6 inches** away from parallel joints in flooring substrates.
3. Match edges of flooring for color shading at seams.
4. Avoid cross seams.

D. Scribe and cut resilient sheet flooring to butt neatly and tightly to vertical surfaces and permanent fixtures, including built-in furniture, cabinets, pipes, outlets, and door frames.

E. Extend resilient sheet flooring into toe spaces, door reveals, closets, and similar openings.

F. Maintain reference markers, holes, and openings that are in place or marked for future cutting by repeating on resilient sheet flooring as marked on substrates. Use chalk or other nonpermanent marking device.

G. Install resilient sheet flooring on covers for telephone and electrical ducts and similar items in installation areas. Maintain overall continuity of color and pattern between pieces of flooring installed on covers and adjoining flooring. Tightly adhere flooring edges to substrates that abut covers and to cover perimeters.

H. Adhere resilient sheet flooring to substrates using a full spread of adhesive applied to substrate to produce a completed installation without open cracks, voids, raising and puckering at joints, telegraphing of adhesive spreader marks, and other surface imperfections.

I. Seamless Installation:

1. Heat-Welded Seams: Comply with ASTM F1516. Rout joints and heat weld with welding bead to fuse sections permanently into a seamless flooring installation. Prepare, weld, and finish seams to produce surfaces flush with adjoining flooring surfaces.
2. Chemically Bonded Seams: Bond seams with chemical-bonding compound to fuse sections permanently into a seamless flooring installation. Prepare seams and apply compound to produce tightly fitted seams without gaps, overlays, or excess bonding compound on flooring surfaces.

J. Integral-Flash Cove Base: Cove resilient sheet flooring to dimension indicated on Drawings up vertical surfaces. Support flooring at horizontal and vertical junction with cove strip. Butt at top against cap strip.

1. Install metal corners at inside and outside corners.

3.4 CLEANING

A. Comply with manufacturer's written instructions for cleaning resilient sheet flooring.

B. Perform the following operations immediately after completing resilient sheet flooring installation:

1. Remove adhesive and other blemishes from surfaces.
2. Sweep and vacuum surfaces thoroughly.
3. Damp-mop surfaces to remove marks and soil.

C. Floor Polish: Remove soil, adhesive, and blemishes from flooring surfaces before applying liquid floor polish.

1. Apply two coat(s).

3.5 PROTECTION

A. Comply with manufacturer's written instructions for protecting resilient sheet flooring.

B. Protect resilient sheet flooring from mars, marks, indentations, and other damage from construction operations and placement of equipment and fixtures during remainder of construction period.

C. Cover resilient sheet flooring until Substantial Completion.

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END OF SECTION 09 65 16

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SECTION 09 65 19 - RESILIENT TILE AND PLANK FLOORING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Commercial luxury vinyl floor tiles.

B. Related Requirements:

1. Section 024119 "Selective Demolition" for removing existing floor coverings.
2. Section 096513 "Resilient Base and Accessories" for wall base and accessories installed with resilient tile and plank flooring.
3. Section 096516 "Resilient Sheet Flooring" for resilient rolled flooring.

1.2 DEFINITIONS

A. LVP: Luxury vinyl planks. A marketing term that is applied to modular resilient floor plank products.

B. LVT: Luxury vinyl tiles. A marketing term that is applied to modular resilient floor tile products.

C. VCT: Vinyl composition tiles. A modular resilient floor tile product composed of binder, fillers, and pigments.

1.3 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1. Review methods and procedures related to resilient tile and plank flooring installation including, but not limited to, the following:

a. Review delivery, storage, and handling procedures.
b. Review ambient conditions and ventilation procedures.
c. Review subfloor preparation procedures.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of specified product.

1. Include manufacturers' written data on physical characteristics, durability, and fade resistance.
2. Include manufacturers' written installation instructions for each type of substrate.

B. Shop Drawings: For each type of resilient flooring type required.

1. Include flooring layouts, edges, columns, doorways, enclosing partitions, built-in furniture, cabinets, and cutouts.
2. Show details of special patterns.

C. Samples: Full-size units of each color, texture, and pattern of resilient flooring type required.

D. Samples for Initial Selection: For each type of resilient flooring product required.

E. Samples for Verification: Full-size units of each color and pattern of resilient flooring type required.

F. Product Schedule: For each type of resilient flooring product required. Use same designations indicated on Drawings.

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1.5 INFORMATIONAL SUBMITTALS

A. Product Test Reports: For resilient flooring, for tests performed by a qualified testing agency.

B. Qualification Statements: For Installer.

1.6 CLOSEOUT SUBMITTALS

A. Maintenance Data: For each type of specified product to include the following:

1. Methods for maintaining resilient flooring, including cleaning and stain-removal products and procedures and manufacturer's recommended maintenance schedule.
2. Precautions for cleaning materials and methods that could be detrimental to resilient flooring.

1.7 MAINTENANCE MATERIAL SUBMITTALS

A. Extra Stock Material: Furnish extra materials , from the same production run, to Owner that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Resilient Tile and Plank Flooring: Furnish no fewer than 1 box for each 50 boxes or fraction thereof, of each type, color, pattern, and size of resilient flooring product installed.

1.8 QUALITY ASSURANCE

A. Installer Qualifications: An entity that employs installers and supervisors who are competent in techniques required by manufacturer for resilient flooring installation and seaming method indicated.

1. Engage an installer who employs workers for this Project who are trained or certified by resilient flooring manufacturer for installation techniques required.

1.9 DELIVERY, STORAGE, AND HANDLING

A. Deliver materials in original packages and containers, with seals unbroken, bearing manufacturers' labels indicating brand name and directions for storing.

B. Store resilient flooring and accessory materials in dry spaces protected from the weather, with ambient temperatures maintained within range recommended by manufacturer, but not less than **50 deg F** or more than **90 deg F**. Store resilient flooring on flat surfaces.

1.10 FIELD CONDITIONS

A. Environmental Limitations: Do not deliver or install resilient flooring until spaces are enclosed and weathertight, wet-work in spaces is complete and dry, and ambient temperature and humidity conditions are maintained at levels planned for building occupants during the remainder of the construction period.

B. Do not install resilient flooring over concrete slabs until slabs have cured and are sufficiently dry to bond with adhesive and concrete slabs have pH range recommended in writing by resilient flooring manufacturer.

C. Adhesively Applied Products:

1. Maintain temperatures during installation within range recommended in writing by manufacturer, but not less than 70 deg F or more than 95 deg F, in spaces to receive flooring 48 hours before installation, during installation, and 48 hours after installation unless longer period is recommended in writing by manufacturer.
2. After postinstallation period, maintain temperatures within range recommended in writing by manufacturer, but not less than 55 deg F or more than 95 deg F.
3. Close spaces to traffic during flooring installation.
4. Close spaces to traffic for 48 hours after flooring installation unless manufacturer recommends longer period in writing.

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1.11 WARRANTY

A. Special Warranty for Resilient Flooring Products: Manufacturer agrees to repair or replace components of flooring installation that fail in materials or workmanship within specified warranty period.

1. Warranty does not include deterioration or failure of flooring due to unusual traffic, failure of substrate, vandalism, or abuse.
2. Warranty Period: 10 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Fire-Test-Response Characteristics: For resilient tile flooring, as determined by testing identical products in accordance with ASTM E648 or ASTM E662 by a qualified testing agency.

1. Critical Radiant Flux Classification: Class I, not less than 0.45 W/sq. cm.

2.2 RESILIENT TILE AND PLANK FLOORING

A. Commercial Luxury Vinyl Floor Tiles: Solid, resilient tile flooring product composed of binder, fillers, and pigments compounded with suitable stabilizers and processing aids; marketed as luxury vinyl tiles (LVT).

1. Basis-of-Design Product: Subject to compliance with requirements, provide As indicated on the drawings or comparable product by one of the following:

   a. Altro
   b. American Biltrite
   c. Armstrong Flooring, Inc.
   d. Flexco Corporation
   e. Gerflor USA
   f. Mannington Mills, Inc
   g. Mohawk Group
   h. Roppe Corporation; Roppe Holding Company
   i. Shaw Industries Group, Inc.; Berkshire Hathaway Company
   j. Tarkett USA
   k. van Gelder, Inc

2. Classification: ASTM F1700, Class II, Surface-Decorated Vinyl Tile.

   a. Type: A, Smooth Surface.

3. Overall Thickness: 0.125 inch including manufacturer's standard clear wear layer and UV-cured polyurethane topcoat.
4. Nominal Size: As indicated on drawings.
5. Colors and Patterns: As indicated by manufacturer's designations.

2.3 INSTALLATION MATERIALS

A. Trowelable Leveling and Patching Compounds: Latex-modified, portland-cement-based or blended hydraulic-cement-based formulation provided or approved by flooring manufacturer for applications indicated.

B. Adhesives: Water-resistant type recommended in writing by floor tile and adhesive manufacturers for substrate and conditions indicated.

C. Vapor Retarder: ASTM D4397, polyethylene sheet not less than 6.0 mils thick.

D. Asphalt-Saturated Felt: ASTM D4869/D4869M, Type II.

E. Seamless-Installation Accessories: Manufacturer's standard product for chemically bonding seams.

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F. Floor Polish: Provide protective, liquid floor-polish products recommended by floor tile manufacturer.

G. Joint Sealant for Resilient Terrazzo Floor Tile: Silicone sealant of type and grade recommended in writing by floor tile manufacturer to suit application.

1. Joint-Sealant Color: As selected by Architect from manufacturer's full range to match floor tile.

H. Sealers and Finish Coats for Resilient Terrazzo Floor Tile: Products recommended by floor tile manufacturer to suit application.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances, moisture content, and other conditions affecting performance of the Work.

1. Verify that finishes of substrates comply with tolerances and other requirements specified in other Sections and that substrates are free of cracks, ridges, depressions, scale, and foreign deposits that might interfere with adhesion of resilient products.

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

1. Installation of resilient flooring products indicates acceptance of surfaces and conditions.

3.2 PREPARATION

A. Prepare substrates in accordance with manufacturer's written installation instructions to ensure adhesion of flooring.

B. Concrete Substrates: Prepare in accordance with ASTM F710.

1. Verify that substrates are dry and free of curing compounds, sealers, and hardeners.
2. Remove substrate coatings and other substances that are incompatible with adhesives and that contain soap, wax, oil, or silicone, using mechanical methods recommended by resilient flooring manufacturer. Do not use solvents.
3. Alkalinity Testing: Perform pH testing in accordance with ASTM F710. Proceed with installation only if pH readings are not less than 7.0 and not greater than 8.5.
4. Moisture Testing: Perform tests so that each test area does not exceed 1000 sq. ft. and perform no fewer than three tests in each installation area and with test areas evenly spaced in installation areas.

   a. Anhydrous Calcium Chloride Test: ASTM F1869. Proceed with installation only after substrates have maximum moisture-vapor-emission rate of 3 lb of water/1000 sq. ft. in 24 hours.
   b. Relative Humidity Test: Using in-situ probes, ASTM F2170. Proceed with installation only after substrates have a maximum 75 percent relative humidity level measurement.

C. Fill cracks, holes, and depressions in substrates with trowelable leveling and patching compound; remove bumps and ridges to produce a uniform and smooth substrate.

D. Move flooring and installation materials into spaces where they will be installed at least 48 hours in advance of installation unless manufacturer recommends a longer period in writing.

1. Do not install flooring until it is the same temperature as space where it is to be installed.

E. Sweep and vacuum clean substrates to be covered by flooring immediately before installation. After cleaning, examine substrates for moisture, alkaline salts, carbonation, and dust. Proceed with installation only after unsatisfactory conditions have been corrected.

3.3 INSTALLATION OF RESILIENT TILE AND PLANK FLOORING

A. Comply with manufacturer's written installation instructions.

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B. Discard broken, cracked, chipped, or deformed tiles.

C. Lay out floor tiles from center marks established with principal walls, discounting minor offsets, so tiles at opposite edges of room are of equal width. Adjust as necessary to avoid using cut widths that equal less than one-half tile at perimeter.

1. Lay tiles in pattern indicated.

D. Tile Matching: Match floor tiles for color and pattern by selecting tiles from cartons in the same sequence as manufactured and packaged, if so numbered.

1. Lay tiles in pattern of colors and sizes indicated.

E. Scribe, cut, and fit floor tiles to butt neatly and tightly to vertical surfaces and permanent fixtures including built-in furniture, cabinets, pipes, outlets, and door frames.

F. Extend floor tiles into toe spaces, door reveals, closets, and similar openings. Extend floor tiles to center of door openings.

G. Maintain reference markers, holes, and openings that are in place or marked for future cutting by repeating on floor tiles as marked on substrates. Use chalk or other nonpermanent marking device.

H. Install floor tiles on covers for telephone and electrical ducts, building expansion-joint covers, and similar items in installation areas. Maintain overall continuity of color and pattern between pieces of tile installed on covers and adjoining tiles. Tightly adhere tile edges to substrates that abut covers and to cover perimeters.

I. Adhered Floor Tile: Adhere floor tiles to substrates using a full spread of adhesive applied to substrate to comply with adhesive and flooring manufacturers' written installation instructions, including those for trowel notching, adhesive mixing, and adhesive open and working times, to produce a completed installation without open cracks, voids, raising and puckering at joints, telegraphing of adhesive spreader marks, and other surface imperfections.

J. Seamless Installation: Bond seams with chemical-bonding compound to fuse sections permanently into a seamless flooring installation. Prepare seams and apply compound to produce tightly fitted seams without gaps, overlays, or excess bonding compound on flooring surfaces.

3.4 CLEANING

A. Comply with manufacturer's written instructions for cleaning flooring.

B. Perform the following operations immediately after completing flooring installation:

1. Remove adhesive and other blemishes from surfaces.
2. Sweep and vacuum surfaces thoroughly.
3. Damp-mop surfaces to remove marks and soil.

C. Floor Polish: Remove soil, adhesive, and blemishes from flooring surfaces before applying liquid floor polish.

1. Apply two coat(s).

D. Joint Sealant: Apply sealant to resilient terrazzo floor tile perimeter and around columns, at door frames, and at other joints and penetrations.

E. Sealers and Finish Coats: Remove soil, visible adhesive, and surface blemishes from resilient terrazzo floor tile surfaces before applying liquid cleaners, sealers, and finish products.

1. Sealer: Apply two base coats of liquid sealer.
2. Finish: Apply two coats of liquid floor finish.

a. Apply finish in accordance with manufacturer's written installation instructions to produce a sealed surface that is ready for use. Do not cover flooring after finishing until finish reaches full cure.

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3.5 PROTECTION

A. Comply with manufacturer's written instructions for protecting flooring.

B. After post-installation cleaning, immediately protect flooring from mars, marks, indentations, and other damage from construction operations and placement of equipment and fixtures during remainder of construction period.

C. Cover resilient flooring until Substantial Completion.

END OF SECTION 09 65 19

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SECTION 09 65 66 - RESILIENT ATHLETIC FLOORING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Resilient athletic sheet flooring.

B. Related Requirements:

1. Section 096513 "Resilient Base and Accessories" for wall base and accessories installed with resilient athletic flooring.

1.2 COORDINATION

A. Coordinate layout and installation of flooring with floor inserts and junction boxes for gymnasium and fitness equipment.

1.3 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1. Review methods and procedures related to resilient athletic flooring installation including, but not limited to, the following:

a. Review delivery, storage, and handling procedures.
b. Review ambient conditions and ventilation procedures.
c. Review subfloor preparation procedures.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of specified product.

1. Include manufacturer's written data on physical characteristics, durability, and fade resistance.
2. Include manufacturer's written installation instructions for each type of substrate.

B. Shop Drawings: Show installation details and locations of the following:

1. Border tiles.
2. Floor patterns.
3. Layout, colors, widths, and dimensions of game lines and markers.
4. Locations of floor inserts for athletic equipment installed through flooring.
5. Locations of junction boxes for fitness equipment installed through flooring.
6. Seam locations for resilient athletic sheet flooring.

C. Samples: For each exposed product and for each type, color, and pattern specified, 6-inch- square in size and of the same thickness indicated for the Work.

1. Game-Line- and Marker-Paint Samples: Include Sample sets showing game-line- and marker-paint colors applied to flooring.
2. Seam Samples: For each type of resilient athletic sheet flooring color and pattern required; with seam running lengthwise and in center of 6-by-9-inch Sample applied to a rigid backing and prepared by Installer for this Project.

D. Samples for Initial Selection: For each type of resilient athletic flooring.

1. Game-Line and Marker Paint: Include charts showing available colors and glosses.

E. Samples for Verification: For each type, color, and pattern of flooring specified, 6-inch- square in size

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and of same thickness and material indicated for the Work.

1. Game-Line- and Marker-Paint Samples: Include Sample sets showing game-line- and marker-paint colors applied to flooring.
2. Seam Samples: For each type of resilient athletic sheet flooring color and pattern required; with seam running lengthwise and in center of 6-by-9-inch Sample applied to a rigid backing and prepared by Installer for this Project.

F. Product Schedule: For resilient athletic flooring. Use same designations indicated on Drawings.

1.5 INFORMATIONAL SUBMITTALS

A. Product Test Reports: For resilient athletic flooring, for tests performed by a qualified testing agency.

B. Qualification Statements: For Installer.

1.6 CLOSEOUT SUBMITTALS

A. Maintenance Data: For resilient athletic flooring.

1. Methods for maintaining resilient athletic flooring, including cleaning and stain-removal products and procedures and manufacturer's recommended maintenance schedule.
2. Precautions for cleaning materials and methods that could be detrimental to resilient athletic flooring.

1.7 MAINTENANCE MATERIAL SUBMITTALS

A. Extra Stock Material: Furnish extra materials, from the same production run, to Owner that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Resilient Athletic Tile Flooring: Furnish no fewer than 1 box for each 50 boxes or fraction thereof, of each type, color, pattern, and size of tile flooring installed.
2. Resilient Athletic Sheet Flooring: Furnish full-width rolls of not less than 10 linear feet for each 500 linear feet or fraction thereof, of each type, color, and pattern of sheet flooring installed.

1.8 QUALITY ASSURANCE

A. Resilient Athletic Sheet Flooring Installer Qualifications: An experienced installer who has completed resilient athletic sheet flooring installations using seaming methods indicated for this Project and similar in material, design, and extent to that indicated for this Project; who is acceptable to manufacturer; and whose work has resulted in installations with a record of successful in-service performance.

1.9 DELIVERY, STORAGE, AND HANDLING

A. Deliver materials in original packages and containers, with seals unbroken, bearing manufacturer's labels indicating brand name and directions for storing.

B. Store materials to prevent deterioration.

1. Store tiles on flat surfaces.
2. Store rolls upright.

1.10 FIELD CONDITIONS

A. Environmental Limitations: Do not deliver or install resilient athletic flooring until spaces are enclosed and weathertight, wet-work in spaces is complete and dry, and ambient temperature and humidity conditions are maintained at levels planned for building occupants during the remainder of the construction period.

B. Do not install resilient athletic flooring over concrete slabs until slabs have cured and are sufficiently

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dry to bond with adhesive and concrete slabs have pH range recommended in writing by resilient athletic flooring manufacturer.

C. Adhesively Applied Products:

1. Maintain temperatures during installation within range recommended in writing by manufacturer, but not less than 70 deg F or more than 95 deg F, in spaces to receive flooring 48 hours before installation, during installation, and 48 hours after installation unless longer period is recommended in writing by manufacturer.
2. After postinstallation period, maintain temperatures within range recommended in writing by manufacturer, but not less than 55 deg F or more than 95 deg F.
3. Close spaces to traffic during flooring installation.
4. Close spaces to traffic for 48 hours after flooring installation unless manufacturer recommends longer period in writing.

PART 2 - PRODUCTS

2.1 RESILIENT ATHLETIC SHEET FLOORING

A. Sheet Vinyl Flooring: Sheet vinyl flooring specifically designed for adhered athletic flooring applications.

1. Basis-of-Design Product: Subject to compliance with requirements, provide As indicated on drawings or comparable product by one of the following:

   a. Aacer Sports Flooring, an Infinity Wood Floors Company
   b. Amarco Products
   c. Connor Sports
   d. Gerflor USA
   e. Johnsonite; a Tarkett company
   f. Tarkett Sports; a division of the Tarkett Group

2. Sheet Vinyl Flooring with Backing: ASTM F1303.

   a. Type (Binder Content): Type I, minimum binder content of 90 percent.
   b. Wear-Layer Thickness: Grade 1.
   c. Overall Thickness: As indicated in drawings.
   d. Interlayer Material: Foamed plastic.
   e. Backing Class: Class B (nonfoamed plastic).

3. Seaming Method: Heat welded.
4. Traffic-Surface Texture: Smooth.
5. Applied Finish: Factory-applied UV urethane.
6. Roll Size: Not less than 48 inches wide by longest length that is practical to minimize splicing during installation.
7. Color and Pattern: As selected by Architect from manufacturer's full range.

2.2 ACCESSORIES

A. Underlayment: Manufacturer's standard rubber sheet.

1. Thickness: 0.12 inch.

B. Trowelable Leveling and Patching Compound: Latex-modified, hydraulic-cement-based formulation approved by flooring manufacturer.

C. Adhesives: Water-resistant type recommended in writing by manufacturer for substrate and conditions indicated.

D. Game-Line and Marker Paint: Complete system including primer, if any, compatible with flooring and recommended in writing by flooring and paint manufacturers for use indicated.

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PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, with Installer present, for compliance with requirements for installation tolerances, moisture content, and other conditions affecting performance of the Work.

1. Verify that finishes of substrates comply with tolerances and other requirements specified in other Sections and that substrates are free of cracks, ridges, depressions, scale, and foreign deposits that might interfere with adhesion of resilient products.

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

3.2 PREPARATION

A. Prepare substrates in accordance with manufacturer's written installation instructions to ensure adhesion of flooring.

B. Concrete Substrates: Prepare in accordance with ASTM F710.

1. Verify that substrates are dry and free of curing compounds, sealers, and hardeners.
2. Alkalinity Testing: Perform pH testing in accordance with ASTM F710. Proceed with installation only if pH readings are not less than 7.0 and not greater than 8.5.
3. Moisture Testing: Perform tests so that each test area does not exceed 1000 sq. ft. and perform no fewer than three tests in each installation area and with test areas evenly spaced in installation areas.

   a. Anhydrous Calcium Chloride Test: ASTM F1869. Proceed with installation only after substrates have maximum moisture-vapor-emission rate of 3 lb of water/1000 sq. ft. in 24 hours.
   b. Relative Humidity Test: Using in-situ probes, ASTM F2170. Proceed with installation only after substrates have a maximum 75 percent relative humidity level measurement.

C. Remove substrate coatings and other substances that are incompatible with adhesives and that contain soap, wax, oil, or silicone, using mechanical methods recommended in writing by manufacturer. Do not use solvents.

D. Use trowelable leveling and patching compound to fill cracks, holes, and depressions in substrates.

E. Move flooring and installation materials into spaces where they will be installed at least 48 hours in advance of installation unless manufacturer recommends a longer period in writing.

1. Do not install flooring until it is the same temperature as space where it is to be installed.

F. Sweep and vacuum clean substrates to be covered by flooring immediately before installation. After cleaning, examine substrates for moisture, alkaline salts, carbonation, and dust. Proceed with installation only after unsatisfactory conditions have been corrected.

3.3 INSTALLATION OF RESILIENT ATHLETIC FLOORING, GENERAL

A. Comply with manufacturer's written installation instructions.

B. Scribe, cut, and fit flooring to butt neatly and tightly to vertical surfaces, equipment anchors, floor outlets, and other interruptions of floor surface.

C. Extend flooring into toe spaces, door reveals, closets, and similar openings unless otherwise indicated.

D. Maintain reference markers, holes, and openings that are in place or marked for future cutting by repeating subfloor markings on flooring. Use nonpermanent, nonstaining marking device.

3.4 INSTALLATION OF RESILIENT ATHLETIC SHEET FLOORING

A. Unroll sheet flooring and allow it to stabilize before cutting and fitting.

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B. Lay out sheet flooring as follows:

1. Maintain uniformity of flooring direction.
2. Minimize number of seams; place seams in inconspicuous and low-traffic areas, at least **6 inches** away from parallel joints in flooring substrates.
3. Match edges of flooring for color shading at seams.
4. Locate seams in accordance with approved Shop Drawings.

C. Adhere products to substrates using a full spread of adhesive applied to substrate to comply with adhesive and flooring manufacturers' written installation instructions, including those for trowel notching, adhesive mixing, and adhesive open and working times.

1. Provide completed installation without open cracks, voids, raising and puckering at joints, telegraphing of adhesive spreader marks, and other surface imperfections.

D. Vinyl Sheet Flooring Seams: Prepare and finish seams to produce surfaces flush with adjoining flooring surfaces.

1. Heat-Welded Seams: Comply with ASTM F1516. Rout joints and use welding bead to permanently fuse sections into a seamless flooring.
2. Chemically Bonded Seams: Comply with ASTM F693. Seal seams to prevent openings from forming between cut edges and to prevent penetration of dirt, liquids, and other substances into seams.

3.5 GAME LINES AND MARKERS

A. Mask flooring at game lines and markers and apply paint to produce sharp edges. Where crossing, break minor game line at intersection; do not overlap lines.

B. Apply game lines and markers in widths and colors in accordance with requirements indicated on Drawings.

3.6 FIELD-APPLIED FINISHES

A. Apply finish after game-line and marker paint is fully cured.

B. Apply finish in accordance with manufacturer's written installation instructions to produce a sealed surface that is ready for use.

C. Do not cover flooring after finishing until finish reaches full cure.

3.7 CLEANING

A. Perform the following operations immediately after completing flooring installation:

1. Remove adhesive and other blemishes from flooring surfaces.
2. Sweep and vacuum flooring thoroughly.
3. Damp-mop flooring to remove marks and soil after time period recommended in writing by manufacturer.

3.8 PROTECTION

A. Protect flooring from mars, marks, indentations, and other damage from construction operations and placement of equipment and fixtures during remainder of construction period. Use protection methods recommended in writing by manufacturer.

1. Do not move heavy and sharp objects directly over flooring. Protect flooring with plywood or hardboard panels to prevent damage from storing or moving objects over flooring.

END OF SECTION 09 65 66

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SECTION 09 68 13 - TILE CARPETING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Carpet tiles.

B. Related Requirements:

1. Section 024119 "Selective Demolition" for removing existing floor coverings.
2. Section 096513 "Resilient Base and Accessories" for resilient wall base and accessories installed with carpet tile.
3. Section 096816 "Sheet Carpeting" for carpet roll goods.

1.2 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1. Review methods and procedures related to carpet tile installation including, but not limited to, the following:

   a. Review delivery, storage, and handling procedures.
   b. Review ambient conditions and ventilation procedures.
   c. Review subfloor preparation procedures.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of specified product.

1. Include manufacturer's written data on physical characteristics, durability, and fade resistance.
2. Include manufacturer's written installation recommendations for each type of substrate.

B. Shop Drawings: For carpet tile installation, showing the following:

1. Columns, doorways, enclosing walls or partitions, built-in cabinets, and locations where cutouts are required in carpet tiles.
2. Carpet tile type, color, and dye lot.
3. Type of subfloor.
4. Type of installation.
5. Pattern of installation.
6. Pattern type, location, and direction.
7. Pile direction.
8. Type, color, and location of insets and borders.
9. Type, color, and location of edge, transition, and other accessory strips.
10. Transition details to other flooring materials.

C. Samples for Initial Selection: Manufacturer's standard color sheets, showing full range of available colors for each type of carpet tile.

1. Include Samples of exposed edge, transition, and other accessory stripping involving color or finish selection.

D. Samples for Verification: Actual Sample of finished products for each of the following products and for each color and texture required. Label each Sample with manufacturer's name, material description, color, pattern, and designation indicated on Drawings and in schedules.

1. Carpet Tile: Full-size Sample.
2. Exposed Edge, Transition, and Other Accessory Stripping: **12-inch-** long Samples.

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E. Product Schedule: For carpet tile. Use same designations indicated on Drawings.

1.4 INFORMATIONAL SUBMITTALS

A. Product Test Reports: For carpet tile, for tests performed by a qualified testing agency.

B. Qualification Statements: For Installer.

C. Sample Warranties: For carpet tile.

1.5 CLOSEOUT SUBMITTALS

A. Maintenance Data: For carpet tiles. Include the following:

1. Methods for maintaining carpet tile, including cleaning and stain-removal products and procedures and manufacturer's recommended maintenance schedule.
2. Precautions for cleaning materials and methods that could be detrimental to carpet tile.

1.6 MAINTENANCE MATERIAL SUBMITTALS

A. Extra Stock Material: Furnish extra materials, from the same production run, to Owner that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Carpet Tile: Full-size units equal to 5 percent of amount installed for each type indicated, but no fewer than 10 full-size units.

1.7 QUALITY ASSURANCE

A. Installer Qualifications: An authorized representative who is certified by the International Certified Floorcovering Installers Association at the Commercial II certification level.

1.8 DELIVERY, STORAGE, AND HANDLING

A. Comply with CRI 104.

1.9 FIELD CONDITIONS

A. Comply with CRI 104 for temperature, humidity, and ventilation limitations.

B. Environmental Limitations: Do not deliver or install carpet tiles until spaces are enclosed and weathertight, wet-work in spaces is complete and dry, and ambient temperature and humidity conditions are maintained at levels planned for building occupants during the remainder of the construction period.

C. Do not install carpet tiles over concrete slabs until slabs have cured and are sufficiently dry to bond with adhesive and concrete slabs have pH range recommended in writing by carpet tile manufacturer.

D. Where demountable partitions or other items are indicated for installation on top of carpet tiles, install carpet tiles before installing these items.

1.10 WARRANTY

A. Special Warranty for Carpet Tiles: Manufacturer agrees to repair or replace components of carpet tile installation that fail in materials or workmanship within specified warranty period.

1. Warranty does not include deterioration or failure of carpet tile due to unusual traffic, failure of substrate, vandalism, or abuse.
2. Failures include, but are not limited to, the following:

a. More than 10 percent loss of face fiber, edge raveling, snags, and runs.
b. Loss of tuft-bind strength.

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c. Excess static discharge.
d. Delamination.
e. Dimensional instability.

3. Warranty Period: 10 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 CARPET TILES

A. Carpet Tile:

1. Basis-of-Design Product: Subject to compliance with requirements, provide As indicated on the drawings or comparable product by one of the following:

   a. Interface, Inc.
   b. Mannington Commercial; a business unit of Mannington Mills, Inc.
   c. Mohawk Group
   d. Shaw Industries Group, Inc.; Berkshire Hathaway Company
   e. Tarkett USA

2. Color: As indicated by manufacturer's designations.
3. Pattern: As indicated on the drawigns.
4. Primary Backing/Backcoating: Manufacturer's standard composite materials.
5. Secondary Backing: Manufacturer's standard material.
6. Size: As indicated on the drawings.
7. Applied Treatments:

   a. Soil-Resistance Treatment: Manufacturer's standard treatment.
   b. Antimicrobial Treatment: Manufacturer's standard treatment that protects carpet tiles as follows:

      1) Antimicrobial Activity: Not less than 2 mm halo of inhibition for gram-positive bacteria, not less than 1 mm halo of inhibition for gram-negative bacteria, and no fungal growth, in accordance with AATCC 174.

2.2 ACCESSORIES

A. Trowelable Leveling and Patching Compounds: Latex-modified, hydraulic-cement-based formulation provided or recommended in writing by carpet tile manufacturer.

B. Adhesives: Water-resistant, mildew-resistant, nonstaining, pressure-sensitive types to suit products and subfloor conditions indicated, that comply with flammability requirements for installed carpet tile, and that are recommended in writing by carpet tile manufacturer for releasable installation.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for maximum moisture content, alkalinity range, installation tolerances, and other conditions affecting carpet tile performance.

B. Examine carpet tile for type, color, pattern, and potential defects.

C. Concrete Slabs: Verify that finishes comply with requirements specified in Section 033000 "Cast-in-Place Concrete" and that surfaces are free of cracks, ridges, depressions, scale, and foreign deposits.

1. Moisture Testing: Perform tests so that each test area does not exceed 1000 sq. ft., and perform no fewer than three tests in each installation area and with test areas evenly spaced in installation areas.

   a. Anhydrous Calcium Chloride Test: ASTM F1869. Proceed with installation only after

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substrates have maximum moisture-vapor-emission rate of 3 lb of water/1000 sq. ft. in 24 hours.

b. Relative Humidity Test: Using in situ probes, ASTM F2170. Proceed with installation only after substrates have a maximum 75 percent relative humidity level measurement.

c. Perform additional moisture tests recommended in writing by adhesive and carpet tile manufacturers. Proceed with installation only after substrates pass testing.

D. Wood Subfloors: Verify the following:

1. Underlayment over subfloor complies with requirements specified in Section 061600 "Sheathing."
2. Underlayment surface is free of irregularities and substances that may interfere with adhesive bond or show through surface.

E. Metal Subfloors: Verify the following:

1. Underlayment surface is free of irregularities and substances that may interfere with adhesive bond or show through surface.

F. Painted Subfloors: Perform bond test recommended in writing by adhesive manufacturer. Verify the following:

1. Underlayment surface is flat, smooth, evenly planed, tightly jointed, and free of irregularities, gaps greater than 1/8 inch, protrusions more than **1/32 inch**, and substances that may interfere with adhesive bond or show through surface.

G. Access Flooring Systems: Verify the following:

1. Access floor substrate is compatible with carpet tile and adhesive if any.

H. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. General: Comply with CRI 104 and with carpet tile manufacturer's written installation instructions for preparing substrates.

B. Trowelable Leving and Patching Compounds: Use trowelable leveling and patching compounds in accordance with manufacturer's written instructions, to fill cracks, holes, depressions, and protrusions in substrates. Fill or level cracks, holes and depressions **1/8 inch** wide or wider, and protrusions more than **1/32 inch** unless more stringent requirements are required by manufacturer's written instructions.

C. Concrete Substrates: Remove coatings, including curing compounds, and other substances that are incompatible with adhesives and that contain soap, wax, oil, or silicone, without using solvents. Use mechanical methods recommended in writing by adhesive and carpet tile manufacturers.

D. Metal Substrates: Clean grease, oil, soil and rust, and prime if recommended in writing by adhesive manufacturer. Rough sand painted metal surfaces and remove loose paint. Sand aluminum surfaces, to remove metal oxides, immediately before applying adhesive.

E. Broom and vacuum clean substrates to be covered immediately before installing carpet tile.

3.3 INSTALLATION OF CARPET TILES

A. General: Comply with CRI 104, Section 10, "Carpet Tile," and with carpet tile manufacturer's written installation instructions.

B. Installation Method: As recommended in writing by carpet tile manufacturer.

C. Maintain dye-lot integrity. Do not mix dye lots in same area.

D. Maintain pile-direction patterns indicated on Drawings.

E. Cut and fit carpet tile to butt tightly to vertical surfaces, permanent fixtures, and built-in furniture including cabinets, pipes, outlets, edgings, thresholds, and nosings. Bind or seal cut edges as

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recommended in writing by carpet tile manufacturer.

F. Extend carpet tile into toe spaces, door reveals, closets, open-bottomed obstructions, removable flanges, alcoves, and similar openings.

G. Maintain reference markers, holes, and openings that are in place or marked for future cutting by repeating on carpet tile as marked on subfloor. Use nonpermanent, nonstaining marking device.

H. Install pattern parallel to walls and borders.

I. Access Flooring: Stagger joints of carpet tiles so carpet tile grid is offset from access flooring panel grid. Do not fill seams of access flooring panels with carpet adhesive; keep seams free of adhesive.

3.4 CLEANING

A. Perform cleaning operations immediately after installing carpet tile as follows:

1. Remove excess adhesive and other surface blemishes using cleaner recommended in writing by carpet tile manufacturer.
2. Remove yarns that protrude from carpet tile surface.
3. Vacuum carpet tile using commercial machine with face-beater element.

3.5 PROTECTION

A. Protect installed carpet tile to comply with CRI 104, Section 13.7.

B. Protect carpet tile against damage from construction operations and placement of equipment and fixtures during the remainder of construction period. Use protection methods indicated or recommended in writing by carpet tile manufacturer.

END OF SECTION 09 68 13

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SECTION 09 91 13 - EXTERIOR PAINTING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes: Surface preparation of exterior substrates and application of the following:

1. Primers.
2. Water-based finish coatings.
3. Solvent-based finish coatings.
4. Floor sealers and paints.

B. Related Requirements:

1. Section 051200 "Structural Steel Framing" for shop priming structural steel substrates.
2. Section 055000 "Metal Fabrications" for shop priming metal fabrications.
3. Section 055113 "Metal Pan Stairs" for shop priming metal pan stairs.
4. Section 055116 "Metal Floor Plate Stairs" for shop priming metal floor plate stairs.
5. Section 055119 "Metal Grating Stairs" for shop priming metal grating stairs.
6. Section 055213 "Pipe and Tube Railings" for shop priming pipe and tube railings.
7. Section 099123 "Interior Painting."

1.2 ACTION SUBMITTALS

A. Product Data: For each type of specified product.

1. Include preparation requirements and application instructions.
2. Indicate VOC content.

B. Samples for Initial Selection: For each type of topcoat product.

C. Samples for Verification: For each type of paint system and each color and gloss of topcoat. Submit actual paint drawdowns as specified below for verification Samples.

1. Submit Samples on rigid backing, **8 inches** square.
2. Apply coats on Samples in steps to show each coat required for system.
3. Label each coat of each Sample.
4. Label each Sample for location and application area.

D. Product List: Cross-reference to paint system and locations of application areas. Use same designations indicated on Drawings and in applicable exterior painting schedule articles to cross-reference paint systems specified in this Section. Include color designations.

1.3 MAINTENANCE MATERIAL SUBMITTALS

A. Extra Stock Material: Furnish extra materials that match paint products applied and that are packaged with protective covering for storage and identified with labels describing contents.

1. Paint Products: 5 percent, but not less than 1 gal. of each material and color applied.

1.4 DELIVERY, STORAGE, AND HANDLING

A. Store materials not in use in tightly covered containers in well-ventilated areas with ambient temperatures continuously maintained at not less than **45 deg F**.

1. Maintain containers in clean condition, free of foreign materials and residue.
2. Remove rags and waste from storage areas daily.

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1.5 FIELD CONDITIONS

A. Apply paints only when temperature of surfaces to be painted and ambient air temperatures are between **50 and 95 deg F**.

B. Do not apply paints in snow, rain, fog, or mist; when relative humidity exceeds 85 percent; at temperatures less than **5 deg F** above the dew point; or to damp or wet surfaces.

PART 2 - PRODUCTS

2.1 SOURCE LIMITATIONS

A. Obtain each paint product from single source from single manufacturer.

2.2 EXTERIOR PAINTS, GENERAL

A. Exterior Paints: Subject to compliance with requirements, available products that may be incorporated into the Work include but are not limited to products listed in product types below and applicable exterior painting schedule articles for the paint category indicated.

B. Material Compatibility:

1. Materials for use within each paint system must be compatible with one another and substrates indicated, under conditions of service and application as demonstrated by manufacturer based on testing and field experience.
2. For each coat in a paint system, provide products recommended in writing by topcoat manufacturer for use in paint system and on substrate indicated.

C. Colors: As indicated in a color schedule on Drawings.

2.3 PRIMERS

A. Alkali-Resistant, Water-Based Primer: Water-based primer formulated for use on alkaline substrates.

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. Behr Paint Company (Behr Process LLC)
b. Benjamin Moore & Co.
c. Hempel (USA), Inc.
d. McCormick Paints
e. Pratt & Lambert; a subsidiary of The Sherwin-Williams Company
f. Rodda Paint Co.
g. Sherwin-Williams Company (The)
h. The Pittsburgh Paints Company

B. Latex Block Filler: Water-based, pigmented, high-solids, emulsion coating formulated to bridge and fill porous surfaces of CMU substrates in preparation for specified subsequent coatings.

C. Water-Based Bonding Primer: Water-based-emulsion primer formulated to promote adhesion of subsequent specified coatings.

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. Behr Paint Company (Behr Process LLC)
b. Benjamin Moore & Co.
c. Hempel (USA), Inc.
d. Rodda Paint Co.
e. Sherwin-Williams Company (The)
f. The Pittsburgh Paints Company

D. Surface-Tolerant Metal Primer: Corrosion-resistant, solvent-based metal primer formulated for use on

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structural steel and metal fabrications that have been minimally prepared.

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. Behr Paint Company (Behr Process LLC)
    b. Benjamin Moore & Co.
    c. Hempel (USA), Inc.
    d. Sherwin-Williams Company (The)
    e. The Pittsburgh Paints Company

E. Water-Based, Galvanized-Metal Primer: Corrosion-resistant, pigmented, acrylic primer; formulated for use on cleaned/etched galvanized metal substrates to prepare it for subsequent water-based coatings.

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. Behr Paint Company (Behr Process LLC)
    b. Benjamin Moore & Co.
    c. Hempel (USA), Inc.
    d. Rodda Paint Co.
    e. Sherwin-Williams Company (The)
    f. The Pittsburgh Paints Company

2.4 WATER-BASED FINISH COATINGS

A. Exterior Latex Paint: Water-based, pigmented coating; formulated for alkali, mold, microbial, and water resistance and for use on exterior substrates.

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. Behr Paint Company (Behr Process LLC)
    b. Benjamin Moore & Co.
    c. Rodda Paint Co.
    d. Sherwin-Williams Company (The)
    e. The Pittsburgh Paints Company

B. Exterior, Water-Based Alkyd Paint: Water-based, pigmented, low-VOC alkyd paint formulated for flash rust and water resistance and for use on exterior substrates.

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. Behr Paint Company (Behr Process LLC)
    b. Benjamin Moore & Co.
    c. Sherwin-Williams Company (The)
    d. The Pittsburgh Paints Company

2. Gloss and Sheen Level: Manufacturer's standard semigloss.

2.5 FLOOR SEALERS AND PAINTS

A. Concrete Stain: Penetrating semitransparent stain specifically manufactured for interior and exterior concrete horizontal and vertical surfaces.

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. Behr Paint Company (Behr Process LLC)
    b. Benjamin Moore & Co.
    c. Sherwin-Williams Company (The)
    d. The Pittsburgh Paints Company

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B. Water-Based, Concrete-Floor Sealer: Clear, water-based, acrylic-copolymer-emulsion sealer formulated for oil, gasoline, alkali, and water resistance and for use on concrete traffic substrates.

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. Behr Paint Company (Behr Process LLC)
b. Hempel (USA), Inc.
c. Sherwin-Williams Company (The)
d. The Pittsburgh Paints Company

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates and conditions, with Applicator present, for compliance with requirements for maximum moisture content and other conditions affecting performance of the Work.

B. Maximum Moisture Content of Substrates: When measured with an electronic moisture meter as follows:

1. Concrete: 12 percent.
2. Cementitious Composition Board: 12 percent.
3. Masonry (Clay and CMU): 12 percent.
4. Wood: 15 percent.
5. Portland Cement Plaster (Stucco): 12 percent. Verify that plaster is fully cured.

C. Verify suitability of substrates, including surface conditions and compatibility, with finishes and primers. Proceed with coating application only after unsatisfactory conditions have been corrected.

1. Application of coating indicates acceptance of substrates and conditions.

3.2 PREPARATION

A. Comply with manufacturer's written instructions applicable to substrates and paint systems indicated.

B. Remove hardware, covers, plates, and similar items already in place that are removable and are not to be painted. If removal is impractical or impossible because of size or weight of item, provide surface-applied protection before surface preparation and painting.

1. After completing painting operations, use workers skilled in the trades involved to reinstall items that were removed. Remove surface-applied protection.

C. Clean substrates of substances that could impair bond of paints, including dust, dirt, oil, grease, and incompatible paints and encapsulants.

1. Remove incompatible primers and reprime substrate with compatible primers or apply tie coat as required to produce paint systems specified in this Section.

D. Concrete Substrates: Remove release agents, curing compounds, efflorescence, and chalk. Do not paint surfaces if moisture content or alkalinity of surfaces to be painted exceeds that permitted in manufacturer's written instructions.

E. Masonry Substrates: Remove efflorescence and chalk. Do not paint surfaces if moisture content or alkalinity of surfaces or mortar joints exceeds that permitted in manufacturer's written instructions.

F. Steel Substrates: Remove loose rust, loose mill scale, loose shop primer, and other loose foreign matter. Clean using methods recommended in writing by paint manufacturer .

G. Shop-Primed Steel Substrates: Clean field welds, bolted connections, and areas where shop paint is abraded. Paint exposed areas with the same material as used for shop priming to comply with SSPC-PA 1 for touching up shop-primed substrates.

H. Galvanized-Metal Substrates: Remove grease and oil residue from galvanized metal by mechanical

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methods to produce clean, lightly etched surfaces that promote adhesion of subsequently applied paints.

I. Aluminum Substrates: Remove loose surface oxidation.

J. Wood Substrates:

1. Scrape and clean knots. Before applying primer, apply coat of wood-knot sealer.
2. Sand surfaces that will be exposed to view and remove sanding dust.
3. Prime edges, ends, faces, undersides, and backsides of wood.
4. After priming, fill holes and imperfections in the finish surfaces with putty or plastic wood filler. Sand smooth when dried.

K. Canvas and Cotton Insulation Covering Substrates: Remove dust, dirt, and other foreign material that might impair bond of paints to substrates.

L. Plastic Trim Fabrication Substrates: Remove dust, dirt, and other foreign material that might impair bond of paints to substrates.

3.3 APPLICATION OF EXTERIOR PAINT PRODUCTS

A. Apply paints in accordance with manufacturer's written instructions.

1. Use applicators and techniques suited for paint and substrate indicated.
2. Paint surfaces behind movable items same as similar exposed surfaces. Before final installation, paint surfaces behind permanently fixed items with prime coat only.
3. Paint both sides and edges of exterior doors and entire exposed surface of exterior door frames.
4. Paint entire exposed surface of window frames and sashes.
5. Do not paint over labels of independent testing agencies or equipment name, identification, performance rating, or nomenclature plates.
6. Primers specified in applicable exterior painting schedule articles may be omitted on items that are factory primed or factory finished if compatible with intermediate and topcoat coatings and acceptable to intermediate and topcoat paint manufacturers.

B. Tint each undercoat a lighter shade to facilitate identification of each coat if multiple coats of same material are to be applied. Tint undercoats to match color of topcoat but provide sufficient difference in shade of undercoats to distinguish each separate coat.

C. If undercoats or other conditions show through topcoat, apply additional coats until cured film has a uniform paint finish, color, and appearance.

D. Apply paints to produce surface films without cloudiness, spotting, holidays, laps, brush marks, roller tracking, runs, sags, ropiness, or other surface imperfections. Cut in sharp lines and color breaks.

E. Painting, Fire-Suppression, Plumbing, HVAC, Electrical, Communication, and Electronic Safety and Security Work:

1. Paint the following work where exposed to view:

a. Equipment, including panelboards and switch gear.
b. Uninsulated metal piping.
c. Uninsulated plastic piping.
d. Pipe hangers and supports.
e. Metal conduit.
f. Plastic conduit.
g. Tanks that do not have factory-applied final finishes.

3.4 FIELD QUALITY CONTROL

A. Dry Film Thickness Testing: Owner may engage the services of a qualified testing and inspecting agency to inspect and test paint for dry film thickness.

1. Touch up and restore painted surfaces damaged by testing.

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2. If test results show that dry film thickness of applied paint does not comply with paint manufacturer's written instructions, apply additional coats as needed to provide dry film thickness that complies with paint manufacturer's written instructions.
3. Cost of retesting is Contractor's responsibility.

3.5 CLEANING

A. At end of each workday, remove rubbish, empty cans, rags, and other discarded materials from Project site.

1. Do not clean equipment with free-draining water and prevent solvents, thinners, cleaners, and other contaminants from entering into waterways, sanitary and storm drain systems, and ground.
2. Dispose of contaminants in accordance with requirements of authorities having jurisdiction.
3. Allow empty paint cans to dry before disposal.
4. Collect waste paint by type and deliver to recycling or collection facility.

B. After completing paint application, clean spattered surfaces. Remove spattered paints by washing, scraping, or other methods. Do not scratch or damage adjacent finished surfaces.

3.6 PROTECTION

A. Protect work of other trades against damage from paint application. Correct damage to work of other trades by cleaning, repairing, replacing, and refinishing, as approved by Architect, and leave in an undamaged condition.

B. At completion of construction activities of other trades, touch up and restore damaged or defaced painted surfaces.

3.7 EXTERIOR PAINTING SCHEDULE, CONCRETE SUBSTRATES

A. Vertical (Nontraffic) Surfaces:

1. Latex System: -

a. Prime Coat: Matching topcoat.
b. Intermediate Coat: Matching topcoat.
c. Topcoat: Exterior latex paint.

1) Gloss and Sheen Level: Gloss.

3.8 EXTERIOR PAINTING SCHEDULE, CEMENTITIOUS SUBSTRATES

A. Cementitious Composition Board Substrates: Siding Trim.

1. Latex System: -

a. Prime Coat: Matching topcoat.
b. Intermediate Coat: Matching topcoat.
c. Topcoat: Exterior latex paint.

1) Gloss and Sheen Level: Semigloss.

B. Portland Cement Plaster (Stucco) Substrates:

1. Latex System: -

a. Prime Coat: Matching topcoat.
b. Intermediate Coat: Matching topcoat.
c. Topcoat: Exterior latex pain.

1) Gloss and Sheen Level: Semigloss.

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3.9 EXTERIOR PAINTING SCHEDULE, MASONRY SUBSTRATES

A. Clay Masonry Substrates:

1. Latex System: -

a. Prime Coat: Matching topcoat.
b. Intermediate Coat: Matching topcoat.
c. Topcoat: Exterior latex paint.

1) Gloss and Sheen Level: Semigloss.

B. CMU Substrates:

1. Latex System: -

a. Prime Coat: Latex block filler.
b. Intermediate Coat: Matching topcoat.
c. Topcoat: Exterior latex paint.

1) Gloss and Sheen Level: Semigloss.

3.10 EXTERIOR PAINTING SCHEDULE, METAL SUBSTRATES

A. Steel and Iron Substrates:

1. Water-Based Alkyd System: -

a. Prime Coat: Alkyd metal primer.
b. Intermediate Coat: Matching topcoat.
c. Topcoat: Exterior, water-based alkyd paint.

1) Gloss and Sheen Level: Semigloss.

B. Galvanized Metal Substrates:

1. Latex System: -

a. Prime Coat: Water-based, galvanized-metal primer.
b. Intermediate Coat: Matching topcoat.
c. Topcoat: Exterior latex paint.

1) Gloss and Sheen Level: Semigloss.

2. Water-Based Alkyd System: -

a. Prime Coat: Water-based, galvanized-metal primer.
b. Intermediate Coat: Matching topcoat.
c. Topcoat: Exterior, water-based alkyd paint.

1) Gloss and Sheen Level: Semigloss.

C. Aluminum (Not Anodized or Otherwise Coated) Substrates:

1. Latex System: -

a. Prime Coat: Quick-drying aluminum primer.
b. Intermediate Coat: Matching topcoat.
c. Topcoat: Exterior latex paint.

1) Gloss and Sheen Level: Semigloss.

2. Water-Based Alkyd System: -

a. Prime Coat: Quick-drying aluminum primer.
b. Intermediate Coat: Matching topcoat.
c. Topcoat: Exterior, water-based alkyd paint.

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1) Gloss and Sheen Level: Semigloss.

3.11 EXTERIOR PAINTING SCHEDULE, WOOD SUBSTRATES

A. Exposed Wood-Framed Substrates:

1. Latex over Latex Primer System: -

a. Prime Coat: Exterior, latex wood primer.
b. Intermediate Coat: Matching topcoat.
c. Topcoat: Exterior latex paint.

1) Gloss and Sheen Level: Semigloss.

2. Water-Based Alkyd System: -

a. Prime Coat: Exterior, latex wood primer.
b. Intermediate Coat: Matching topcoat.
c. Topcoat: Exterior, water-based alkyd paint.

1) Gloss and Sheen Level: Semigloss.

B. Dressed-Wood Substrates: Wood trim.

1. Latex over Latex Primer System: -

a. Prime Coat: Exterior, latex wood primer.
b. Intermediate Coat: Matching topcoat.
c. Topcoat: Exterior latex paint.

1) Gloss and Sheen Level: Semigloss.

2. Water-Based Alkyd System: -

a. Prime Coat: Exterior, latex wood primer.
b. Intermediate Coat: Matching topcoat.
c. Topcoat: Exterior, water-based alkyd paint.

1) Gloss and Sheen Level: Semigloss.

C. Wood-Based Panel Substrates:

1. Latex over Latex Primer System: -

a. Prime Coat: Exterior, latex wood primer.
b. Intermediate Coat: Matching topcoat.
c. Topcoat: Exterior latex paint.

1) Gloss and Sheen Level: Semigloss.

END OF SECTION 09 91 13

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SECTION 09 91 23 - INTERIOR PAINTING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes: Surface preparation of interior substrates and application of the following:

1. Primers.
2. Water-based finish coatings.
3. Solvent-based finish coatings.
4. Floor sealers and paints.
5. Dry fall coatings.

B. Related Requirements:

1. Section 051200 "Structural Steel Framing" for shop priming structural steel substrates.
2. Section 055000 "Metal Fabrications" for shop priming metal fabrications.
3. Section 055113 "Metal Pan Stairs" for shop priming metal pan stairs.
4. Section 055213 "Pipe and Tube Railings" for shop priming pipe and tube railings.
5. Section 099113 "Exterior Painting."

1.2 ACTION SUBMITTALS

A. Product Data: For each type of specified product.

1. Include preparation requirements and application instructions.
2. Indicate VOC content.

B. Samples: For each type of topcoat product.

C. Samples for Initial Selection: For each type of topcoat product.

D. Samples for Verification: For each type of paint system and each color and gloss of topcoat. Submit actual paint drawdowns as specified below for verification Samples.

1. Submit Samples on rigid backing, **8 inches** square.
2. Apply coats on Samples in steps to show each coat required for system.
3. Label each coat of each Sample.
4. Label each Sample for location and application area.

E. Product List: Cross-reference to paint system and locations of application areas. Use same designations indicated on Drawings and in applicable interior painting schedule articles to cross-reference paint systems specified in this Section. Include color designations.

1.3 MAINTENANCE MATERIAL SUBMITTALS

A. Extra Stock Material: Furnish extra materials that match paint products applied and that are packaged with protective covering for storage and identified with labels describing contents.

1. Paint Products: 5 percent, but not less than 1 gal. of each material and color applied.

1.4 MOCKUPS

A. Apply mockups of each paint system indicated and each color and finish selected to verify selections made under Sample submittals, to demonstrate aesthetic effects, and to set quality standards for materials and execution.

1. Architect will select one surface to represent surfaces and conditions for application of each paint system.

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a. Vertical and Horizontal Surfaces: Provide samples of at least **100 sq. ft.**.
b. Other Items: Architect will designate items or areas required.

2. Final approval of color selections will be based on mockups.

a. If preliminary color selections are not approved, apply additional mockups of additional colors selected by Architect at no added cost to Owner.

3. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Owner specifically approves such deviations by Change Order.
4. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Store materials not in use in tightly covered containers in well-ventilated areas with ambient temperatures continuously maintained at not less than **45 deg F**.

1. Maintain containers in clean condition, free of foreign materials and residue.
2. Remove rags and waste from storage areas daily.

1.6 FIELD CONDITIONS

A. Apply paints only when temperature of surfaces to be painted and ambient air temperatures are between **50 and 95 deg F**.

B. Do not apply paints when relative humidity exceeds 85 percent; at temperatures of less than **5 deg F** above the dew point; or to damp or wet surfaces.

PART 2 - PRODUCTS

2.1 SOURCE LIMITATIONS

A. Obtain each paint product from single source from single manufacturer.

2.2 INTERIOR PAINTS, GENERAL

A. Interior Paints: Subject to compliance with requirements, available products that may be incorporated into the Work include but are not limited to products listed in product types below and applicable interior painting schedule articles for the paint category indicated.

B. Material Compatibility:

1. Materials for use within each paint system must be compatible with one another and substrates indicated, under conditions of service and application as demonstrated by manufacturer based on testing and field experience.
2. For each coat in a paint system, provide products recommended in writing by topcoat manufacturer for use in paint system and on substrate indicated.

C. Colors: As indicated in a color schedule.

2.3 PRIMERS

A. Latex Block Filler: Water-based, pigmented, high-solids, emulsion coating formulated to bridge and fill porous surfaces of CMU substrates in preparation for specified subsequent coatings.

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. Behr Paint Company (Behr Process LLC)
b. Benjamin Moore & Co.
c. Rust-Oleum Corporation

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d. Sherwin-Williams Company (The)
e. The Pittsburgh Paints Company
f. Valspar; a brand of The Sherwin-Williams Company

B. Interior Latex Primer Sealer: Pigmented, water-based latex sealer; formulated to reduce porosity of substrate for finish coats; for use on new interior plaster, concrete, and gypsum board substrates. Not intended for use on wood or previously painted surfaces.

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. Benjamin Moore & Co.
b. Hempel (USA), Inc.
c. McCormick Paints
d. Rodda Paint Co.
e. Sherwin-Williams Company (The)
f. The Pittsburgh Paints Company

C. Water-Based Alkyd Primer Sealer: Waterborne-emulsion primer/sealer formulated for new interior gypsum board and plaster substrates.

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. Behr Paint Company (Behr Process LLC)
b. Benjamin Moore & Co.
c. Rodda Paint Co.
d. Sherwin-Williams Company (The)
e. The Pittsburgh Paints Company

D. Water-Based, Galvanized-Metal Primer: Corrosion-resistant, pigmented, acrylic primer; formulated for use on cleaned/etched galvanized metal substrates to prepare it for subsequent water-based coatings.

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. Behr Paint Company (Behr Process LLC)
b. Benjamin Moore & Co.
c. Rodda Paint Co.
d. Sherwin-Williams Company (The)
e. The Pittsburgh Paints Company

E. Water-Based Bonding Primer: Water-based-emulsion primer formulated to promote adhesion of subsequent specified coatings.

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. Behr Paint Company (Behr Process LLC)
b. Benjamin Moore & Co.
c. Sherwin-Williams Company (The)
d. The Pittsburgh Paints Company
e. Valspar; a brand of The Sherwin-Williams Company

2.4 WATER-BASED FINISH COATINGS

A. Interior Latex Paint: Pigmented, water-based coating for use on interior primed/sealed plaster and gypsum board, and on primed wood and metals.

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. Behr Paint Company (Behr Process LLC)
b. Benjamin Moore & Co.
c. McCormick Paints

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d. Rodda Paint Co.
e. Sherwin-Williams Company (The)
f. The Pittsburgh Paints Company
g. Valspar; a brand of The Sherwin-Williams Company

2.5 DRY FALL COATINGS

A. Dry Fall, Latex: Pigmented, water-based, emulsion-type, fast-drying coating for use on interior plaster, concrete, gypsum board, primed wood, and metal ceilings.

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. Behr Paint Company (Behr Process LLC)
b. Benjamin Moore & Co.
c. McCormick Paints
d. Rodda Paint Co.
e. Sherwin-Williams Company (The)
f. The Pittsburgh Paints Company
g. Valspar; a brand of The Sherwin-Williams Company

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates and conditions, with Applicator present, for compliance with requirements for maximum moisture content and other conditions affecting performance of the Work.

B. Maximum Moisture Content of Substrates: When measured with an electronic moisture meter as follows:

1. Concrete: 12 percent.
2. Cementitious Composition Board: 12 percent.
3. Masonry (Clay and CMU): 12 percent.
4. Wood: 15 percent.
5. Gypsum Board: 12 percent. Verify that finishing compound is dry and sanded smooth.
6. Plaster: 12 percent. Verify that plaster is fully cured.

C. Verify suitability of substrates, including surface conditions and compatibility, with finishes and primers. Proceed with coating application only after unsatisfactory conditions have been corrected.

1. Application of coating indicates acceptance of surfaces and conditions.

3.2 PREPARATION

A. Comply with manufacturer's written instructions applicable to substrates and paint systems indicated.

B. Remove hardware, covers, plates, and similar items already in place that are removable and are not to be painted. If removal is impractical or impossible because of size or weight of item, provide surface-applied protection before surface preparation and painting.

1. After completing painting operations, use workers skilled in the trades involved to reinstall items that were removed. Remove surface-applied protection if any.

C. Clean substrates of substances that could impair bond of paints, including dust, dirt, oil, grease, and incompatible paints and encapsulants.

1. Remove incompatible primers and reprime substrate with compatible primers or apply tie coat as required to produce paint systems indicated.

D. Concrete Substrates: Remove release agents, curing compounds, efflorescence, and chalk. Do not paint surfaces if moisture content or alkalinity of surfaces to be painted exceeds that permitted in manufacturer's written instructions.

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E. Masonry Substrates: Remove efflorescence and chalk. Do not paint surfaces if moisture content or alkalinity of surfaces or mortar joints to be painted exceeds that permitted in manufacturer's written instructions.

F. Steel Substrates: Remove loose rust, loose mill scale, loose shop primer, and other loose foreign matter. Clean using methods recommended in writing by paint manufacturer .

G. Shop-Primed Steel Substrates: Clean field welds, bolted connections, and areas where shop paint is abraded. Paint exposed areas with the same material as used for shop priming to comply with SSPC-PA 1 for touching up shop-primed surfaces.

H. Galvanized Metal Substrates: Remove grease and oil residue from galvanized metal by mechanical methods to produce clean, lightly etched surfaces that promote adhesion of subsequently applied paints.

I. Aluminum Substrates: Remove loose surface oxidation.

J. Wood Substrates:

1. Scrape and clean knots. Before applying primer, apply coat of wood-knot sealer.
2. Sand surfaces that will be exposed to view and remove sanding dust.
3. Prime edges, ends, faces, undersides, and backsides of wood.
4. After priming, fill holes and imperfections in the finish surfaces with putty or plastic wood filler. Sand smooth when dried.

K. Canvas and Cotton Insulation Covering Substrates: Remove dust, dirt, and other foreign material that might impair bond of paints to substrates.

L. Plastic Trim Fabrication Substrates: Remove dust, dirt, and other foreign material that might impair bond of paints to substrates.

3.3 APPLICATION OF INTERIOR PAINT PRODUCTS

A. Apply paints in accordance with manufacturer's written instructions.

1. Use applicators and techniques suited for paint and substrate indicated.
2. Paint surfaces behind movable equipment and furniture same as similar exposed surfaces. Before final installation, paint surfaces behind permanently fixed equipment or furniture with prime coat only.
3. Paint front and backsides of access panels, removable or hinged covers, and similar hinged items to match exposed surfaces.
4. Paint entire exposed surface of window frames and sashes.
5. Do not paint over labels of independent testing agencies or equipment name, identification, performance rating, or nomenclature plates.
6. Primers specified in the applicable interior painting schedule articles may be omitted on items that are factory primed or factory finished if compatible with intermediate and topcoat coatings and acceptable to intermediate and topcoat paint manufacturers.

B. Tint each undercoat a lighter shade to facilitate identification of each coat if multiple coats of same material are to be applied. Tint undercoats to match color of topcoat but provide sufficient difference in shade of undercoats to distinguish each separate coat.

C. If undercoats or other conditions show through topcoat, apply additional coats until cured film has a uniform paint finish, color, and appearance.

D. Apply paints to produce surface films without cloudiness, spotting, holidays, laps, brush marks, roller tracking, runs, sags, ropiness, or other surface imperfections. Cut in sharp lines and color breaks.

E. Painting Fire-Suppression, Plumbing, HVAC, Electrical, Communication, and Electronic Safety and Security Work:

1. Paint the following work where exposed to view in equipment rooms:

a. Equipment, including panelboards and switch gear.
b. Uninsulated metal piping.

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c. Uninsulated plastic piping.
d. Pipe hangers and supports.
e. Metal conduit.
f. Plastic conduit.
g. Tanks that do not have factory-applied final finishes.
h. Duct, equipment, and pipe insulation having cotton or canvas insulation covering or other paintable jacket material.

2. Paint the following work where exposed to view in occupied spaces:

a. Equipment, including panelboards.
b. Uninsulated metal piping.
c. Uninsulated plastic piping.
d. Pipe hangers and supports.
e. Metal conduit.
f. Plastic conduit.
g. Duct, equipment, and pipe insulation having cotton or canvas insulation covering or other paintable jacket material.
h. Other items as directed by Architect.

3. Paint portions of internal surfaces of metal ducts, without liner, behind air inlets and outlets that are visible from occupied spaces.

3.4 FIELD QUALITY CONTROL

A. Dry-Film Thickness Testing: Owner may engage the services of a qualified testing and inspecting agency to inspect and test paint for dry-film thickness.

1. Touch up and restore painted surfaces damaged by testing.
2. If test results show that dry-film thickness of applied paint does not comply with paint manufacturer's written recommendations, apply additional coats as needed to provide dry-film thickness that complies with paint manufacturer's written recommendations.
3. Cost of retesting is Contractor's responsibility.

3.5 CLEANING

A. At end of each workday, remove rubbish, empty cans, rags, and other discarded materials from Project site.

1. Do not clean equipment with free-draining water and prevent solvents, thinners, cleaners, and other contaminants from entering into waterways, sanitary and storm drain systems, and ground.
2. Dispose of contaminants in accordance with requirements of authorities having jurisdiction.
3. Allow empty paint cans to dry before disposal.
4. Collect waste paint by type and deliver to recycling or collection facility.

B. After completing paint application, clean spattered surfaces. Remove spattered paints by washing, scraping, or other methods. Do not scratch or damage adjacent finished surfaces.

3.6 PROTECTION

A. Protect work of other trades against damage from paint application. Correct damage to work of other trades by cleaning, repairing, replacing, and refinishing, as approved by Architect, and leave in an undamaged condition.

B. At completion of construction activities of other trades, touch up and restore damaged or defaced painted surfaces.

3.7 INTERIOR PAINTING SCHEDULE, CONCRETE SUBSTRATES

A. Vertical (Nontraffic) Surfaces:

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1. Latex System: -

    a. Prime Coat: Matching topcoat.
    b. Intermediate Coat: Matching topcoat.
    c. Topcoat: Interior latex paint.

        1) Gloss and Sheen Level: Semigloss.

2. Concrete Stain System: -

    a. First Coat: Matching topcoat.
    b. Topcoat: Concrete stain.

3.8 INTERIOR PAINTING SCHEDULE, CEMENTITIOUS SUBSTRATES

A. Cementitious Composition Board Substrates: Trim.

1. Latex System: <**Insert drawing designation.**>

    a. Prime Coat: Alkali-resistant, water-based primer.
    b. Intermediate Coat: Matching topcoat.
    c. Topcoat: Interior latex paint.

        1) Gloss and Sheen Level: Semigloss.

3.9 INTERIOR PAINTING SCHEDULE, MASONRY SUBSTRATES

A. Clay Masonry Substrates:

1. Latex System: -

    a. Prime Coat: Alkali-resistant, water-based primer.
    b. Intermediate Coat: Matching topcoat.
    c. Topcoat: Interior latex paint.

        1) Gloss and Sheen Level: Semigloss.

B. CMU Substrates:

1. Latex System: -

    a. Block Filler: Latex block filler.
    b. Intermediate Coat: Matching topcoat.
    c. Topcoat: Interior latex paint.

        1) Gloss and Sheen Level: Semigloss.

3.10 INTERIOR PAINTING SCHEDULE, METAL SUBSTRATES

A. Steel and Iron Substrates:

1. Latex System, Alkyd Primer: -

    a. Prime Coat: Alkyd metal primer.
    b. Intermediate Coat: Matching topcoat.
    c. Topcoat: Interior latex paint.

        1) Gloss and Sheen Level: Semigloss.

2. Latex over Shop-Applied, Quick-Drying Shop Primer System: -

    a. Prime Coat: Shop primer.
    b. Intermediate Coat: Matching topcoat.
    c. Topcoat: Interior latex paint.

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1) Gloss and Sheen Level: Semigloss.

3. Water-Based Dry-Fall System: -

a. Prime Coat: Shop primer specified in Section where substrate is specified.
b. Topcoat: .

1) Gloss and Sheen Level: Semigloss.

4. Water-Based Alkyd System: -

a. Prime Coat: Surface-tolerant metal primer.
b. Intermediate Coat: Matching topcoat.
c. Topcoat: Interior, water-based alkyd paint.

1) Gloss and Sheen Level: .

B. Galvanized Metal Substrates:

1. Water-Based Alkyd System: -

a. Prime Coat: Water-based, galvanized-metal primer.
b. Intermediate Coat: Matching topcoat.
c. Topcoat: Interior, water-based alkyd paint.

1) Gloss and Sheen Level: Semigloss.

2. Aluminum Paint System: -

a. Prime Coat: Water-based, galvanized-metal primer.
b. Intermediate Coat: Matching topcoat.
c. Topcoat: Aluminum paint.

C. Aluminum (Not Anodized or Otherwise Coated) Substrates:

1. Latex System: -

a. Prime Coat: Quick-drying aluminum primer.
b. Intermediate Coat: Matching topcoat.
c. Topcoat: Interior latex paint.

1) Gloss and Sheen Level: Semigloss.

2. Water-Based Alkyd System: -

a. Prime Coat: Quick-drying aluminum primer.
b. Intermediate Coat: Matching topcoat.
c. Topcoat: Interior, water-based alkyd paint.

1) Gloss and Sheen Level: Semigloss.

3.11 INTERIOR PAINTING SCHEDULE, WOOD SUBSTRATES

A. Exposed Wood Framed Substrates:

1. Latex over Latex Primer System: -

a. Prime Coat: Interior, latex primer for wood.
b. Intermediate Coat: Matching topcoat.
c. Topcoat: Interior latex paint.

1) Gloss and Sheen Level: Semigloss.

B. Finish Carpentry Substrates: Wood trim.

1. Latex over Latex Primer System: -

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a. Prime Coat: Interior, latex primer for wood.
b. Intermediate Coat: Matching topcoat.
c. Topcoat: Interior latex paint.

1) Gloss and Sheen Level: Semigloss.

C. Architectural Woodwork Substrates: Casework.

1. Latex over Latex Primer System: -

a. Prime Coat: Interior, latex primer for wood.
b. Intermediate Coat: Matching topcoat.
c. Topcoat: Interior latex paint.

1) Gloss and Sheen Level: Semigloss.

3.12 INTERIOR PAINTING SCHEDULE, GYPSUM-BASED SUBSTRATES

A. Gypsum Board and Plaster Substrates:

1. Latex over Latex Sealer System: -

a. Prime Coat: Interior latex primer sealer.
b. Intermediate Coat: Matching topcoat.
c. Topcoat: Interior latex paint.

1) Gloss and Sheen Level: Semigloss.

3.13 INTERIOR PAINTING SCHEDULE, MISCELLANEOUS SUBSTRATES

A. Fiberglass Substrates:

1. Latex System: -

a. Prime Coat: Water-based bonding primer.
b. Intermediate Coat: Matching topcoat.
c. Topcoat: Interior latex paint.

1) Gloss and Sheen Level: Semigloss.

B. Plastic Trim Fabrication Substrates:

1. Latex System: -

a. Prime Coat: Water-based bonding primer.
b. Intermediate Coat: Matching topcoat.
c. Topcoat: Interior latex paint.

1) Gloss and Sheen Level: Semigloss.

2. Water-Based Alkyd System: -

a. Prime Coat: Water-based bonding primer.
b. Intermediate Coat: Matching topcoat.
c. Topcoat: Interior, water-based alkyd paint.

1) Gloss and Sheen Level: Semigloss.

C. Acoustic Panels and Tiles:

1. Latex, Flat System: -

a. Prime Coat: Matching topcoat.
b. Topcoat: Interior latex paint.

1) Gloss and Sheen Level: Flat.

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END OF SECTION 09 91 23

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SECTION 10 11 00 - VISUAL DISPLAY UNITS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Visual display board assemblies.
2. Standalone visual display rails.

1.2 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of specified product.

1. Include construction details, material descriptions, dimensions of individual components and profiles, finishes, and accessories for visual display units.

B. Shop Drawings: For visual display units.

1. Include plans, elevations, sections, and attachment details.
2. Show locations of panel joints. Show locations of field-assembled joints for factory-fabricated units too large to ship in one piece.
3. Show locations and layout of special-purpose graphics.
4. Include sections of typical trim members.

C. Samples for Initial Selection: For each type of visual display unit indicated, for units with factory-applied color finishes, and as follows:

1. Samples of facings for each visual display panel type, indicating color and texture.
2. Fabric swatches of fabric facings for tackboards.
3. Actual factory-finish color samples, applied to aluminum substrate.
4. Include accessory Samples to verify color selected.

D. Samples for Verification: For each type of visual display unit indicated.

1. Visual Display Panel: Not less than **8-1/2 by 11 inches**, with facing, core, and backing indicated for final Work. Include one panel for each type, color, and texture required.
2. Trim: **6-inch-** long sections of each trim profile.
3. Display Rail: **6-inch-** long section of each type.
4. Accessories: Full-size Sample of each type of accessory.

E. Product Schedule: For visual display units. Use same designations indicated on Drawings.

1.4 INFORMATIONAL SUBMITTALS

A. Product Test Reports: For each visual display unit, for tests performed by a qualified testing agency.

B. Qualification Statements: For Installer.

C. Sample Warranties: For specified special warranties.

1.5 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For visual display units .

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1.6 QUALITY ASSURANCE

A. Installer Qualifications: Entity that employs installers and supervisors who are trained and approved by manufacturer.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Deliver factory-fabricated visual display units completely assembled in one piece. If dimensions exceed maximum manufactured unit size, or if unit size is impracticable to ship in one piece, provide two or more pieces with joints in locations indicated on approved Shop Drawings.

1.8 FIELD CONDITIONS

A. Environmental Limitations: Deliver and install visual display units when spaces are enclosed and weathertight, wet-work in spaces is complete and dry, work above ceilings is complete, and temporary HVAC system is operating and maintaining ambient temperature and humidity conditions at occupancy levels during the remainder of the construction period.

1.9 WARRANTY

A. Special Warranty for Porcelain-Enamel-Faced Sheets: Manufacturer agrees to repair or replace porcelain-enamel-faced sheets that fail in materials or workmanship within specified warranty period.

1. Failures include, but are not limited to, the following:

    a. Surfaces lose original writing and erasing qualities.
    b. Surfaces exhibit crazing, cracking, or flaking.

2. Warranty Period:

    a. 50 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Surface-Burning Characteristics: Comply with ASTM E84; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.

1. Flame-Spread Index: 25 or less.
2. Smoke-Developed Index: 450 or less.

2.2 VISUAL DISPLAY BOARD ASSEMBLIES

A. Visual Display Board:

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. A-1 Visual Systems
    b. Aarco Products, Inc.
    c. AJW Architectural Products
    d. ASI American Specialties, Inc.; ASI Group
    e. Claridge Products and Equipment, LLC.
    f. Delta Products Ltd
    g. EVERWhite Whiteboards
    h. GMi Companies, Inc.
    i. Magna Visual Corp.
    j. Massey Capital
    k. MooreCo Inc
    l. Platinum Visual Solutions

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2. Assembly: Factory fabricated.

    a. Corners: Square.
    b. Width: As indicated on Drawings.
    c. Height: As indicated on Drawings.

3. Panel Type:

    a. Chalkboard: Porcelain-enamel-faced panel .

        1) Core Material:

            a) Manufacturer's Standard: Minimum **1/4 inch** thick, with manufacturer's standard moisture-barrier backing for use with magnets.
            b) Hardboard: **1/4 inch** thick; with 0.0129-inch- thick, galvanized-steel sheet backing for use with magnets.
            c) Particleboard: **3/8 inch** thick; with 0.0129-inch- thick, galvanized-steel sheet backing for use with magnets.
            d) Fiberboard: 3/8 inch thick; with 0.0129-inch- thick, galvanized-steel sheet backing for use with magnets.
            e) backing for use with magnets.
            f) Medium Density Fiberboard (MDF): **7/16 inch** thick; with manufacturer's standard steel backing.

        2) Color: Black.

    b. Markerboard: Porcelain-enamel-faced panel.

        1) Core Material:

            a) Manufacturer's Standard: Minimum **1/4 inch** thick, with manufacturer's standard moisture-barrier backing.
            b) Hardboard: **1/4 inch** thick; with 0.0129-inch- thick, galvanized-steel sheet backing for use with magnets.
            c) Particleboard: **3/8 inch** thick; with 0.0129-inch- thick, galvanized-steel sheet backing for use with magnets.
            d) Fiberboard: 3/8 inch thick; with 0.0129-inch- thick, galvanized-steel sheet backing for use with magnets.

        2) Color: White.

    c. Tackboard: Colored-cork panel on fiberboard core.

        1) Core Material:

            a) Manufacturer's standard.

        2) Color and Pattern: As indicated by manufacturer's designations.

4. Trim:

    a. Aluminum Frames and Trim:

        1) Factory-Applied Trim: Fabricated from not less than **0.062-inch-** thick, extruded aluminum; standard size and shape.
        2) Finish: Clear anodic finish.

5. Accessories:

    a. Tray: Manufacturer's standard; continuous chalk or marker tray.

        1) Box Type: Extruded magnetic aluminum with slanted front, grooved tray, and cast-aluminum end closures.
        2) Solid Type: Extruded magnetic aluminum with ribbed section and smoothly curved exposed ends.

    b. Display Rail: Manufacturer's standard, extruded-aluminum display rail with colored-cork

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insert, end stops, and continuous paper holder, designed to hold accessories.

1) Size: 1 inch high by full length of visual display unit.
2) Map Hooks and Clips: Two map hooks with flexible metal clips for every 48 inches of display rail or fraction thereof.
3) Flag Holder: One for each room.
4) Tackboard Insert Color: As indicated by manufacturer's designation.
5) Aluminum Color: Match finish of visual display assembly trim.
6) Paper Holder Display Rail: Extruded aluminum; designed to hold paper by clamping action.

2.3 STANDALONE VISUAL DISPLAY RAILS

A. Display Rail:

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. AJW Architectural Products
   b. Claridge Products and Equipment, LLC.
   c. GMi Companies, Inc.
   d. MooreCo Inc

2. Aluminum Display Rail: Manufacturer's standard, extruded-aluminum rail with colored-cork tackable insert, and continuous paper holder, designed to hold accessories.
3. Paper Holder Display Rail: Extruded aluminum rail; designed to hold paper by clamping action.

   a. Finish: Clear anodic finish.

4. Accessories:

   a. Map Hooks: Include two Metal map hooks per 8 ft. of installed display rail.
   b. Flag Holders: Include one flag holder per room.

2.4 MATERIALS

A. Porcelain-Enamel-Faced Sheet: PEI-1002, with face sheet manufacturer's standard two- or three-coat process.

B. High-Pressure Decorative Laminate: ISO 4586-3.

C. Colored-Cork Sheet: Seamless, homogeneous, self-sealing sheet consisting of granulated cork, linseed oil, resin binders, and dry pigments that are mixed and calendared onto fabric backing; with integral color throughout ; with surface-burning characteristics indicated.

D. Hardboard: ANSI A135.4, tempered.

E. Particleboard: ANSI A208.1, Grade M-1.

F. Fiberboard: ASTM C208 cellulosic fiber insulating board.

G. Medium Density Fiberboard (MDF): ANSI A208.2, Grade 130.

H. Clear Tempered Glass: ASTM C1048, Kind FT, Condition A, Type I, Class 1, Quality Q3, with exposed edges seamed before tempering.

I. Extruded Aluminum: **ASTM B221**, Alloy 6063.

J. Adhesives for Field Application: Mildew-resistant, nonstaining adhesive for use with specific type of panels, sheets, or assemblies; and for substrate application; as recommended in writing by visual display unit manufacturer.

K. Primer/Sealer: Mildew-resistant primer/sealer complying with requirements in Section 099123 "Interior Painting" and recommended in writing by visual display unit manufacturer for intended substrate.

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2.5 ALUMINUM FINISHES

A. Clear Anodic Finish: AAMA 611, AA-M12C22A31, Class II, 0.010 mm or thicker.

B. Color Anodic Finish: AAMA 611, AA-M12C22A32/A34, Class II, 0.010 mm or thicker.

C. Baked-Enamel or Powder-Coat Finish: AAMA 2603, except with a minimum dry film thickness of **1.5 mils**. Comply with coating manufacturer's written instructions for cleaning, conversion coating, and applying and baking finish.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates and conditions, with Installer present, for compliance with requirements for installation tolerances, surface conditions of wall, and other conditions affecting performance of the Work.

B. Examine roughing-in for electrical power systems to verify actual locations of connections before installation of motorized, sliding visual display units.

C. Examine walls and partitions for proper preparation and backing for visual display units.

D. Examine walls and partitions for suitable framing depth where sliding visual display units will be installed.

E. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Comply with manufacturer's written instructions for surface preparation.

B. Clean substrates of substances, such as dirt, mold, and mildew, that could impair the performance of and affect the smooth, finished surfaces of visual display boards.

C. Prepare surfaces to achieve a smooth, dry, clean surface free of flaking, unsound coatings, cracks, defects, projections, depressions, and substances that will impair bond between visual display units and wall surfaces.

D. Prime wall surfaces indicated to receive visual display units and as recommended in writing by primer/sealer manufacturer and visual display unit manufacturer.

E. Prepare recesses for sliding visual display units as required by type and size of unit.

3.3 INSTALLATION OF VISUAL DISPLAY UNITS, GENERAL

A. Install visual display units in accordance with manufacturer's written instructions.

B. Install visual display surfaces in locations and at mounting heights indicated on Drawings, or if not indicated, at heights indicated below. Keep perimeter lines straight, level, and plumb. Provide grounds, clips, backing materials, adhesives, brackets, anchors, trim, and accessories necessary for complete installation.

3.4 INSTALLATION OF VISUAL DISPLAY BOARD ASSEMBLIES

A. Factory-Fabricated Visual Display Board Assemblies:

1. Attach concealed clips, hangers, and grounds to wall surfaces and to visual display board assemblies with fasteners at not more than **16 inches** o.c. Secure tops and bottoms of boards to walls.
2. Adhere to wall surfaces in accordance with manufacturer's written instructions.

B. Field-Assembled Visual Display Board Assemblies: Coordinate field-assembled units with grounds,

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trim, and accessories indicated. Join parts with a neat, precision fit.

1. Make joints only where total length exceeds maximum manufactured length. Fabricate with minimum number of joints, balanced around center of board, as acceptable to Architect.
2. Where size of visual display board assemblies or other conditions require support in addition to normal trim, provide structural supports or modify trim as indicated or as selected by Architect from manufacturer's standard structural support accessories to suit conditions indicated.

C. Mounting Heights: Install at heights indicated below:

1. For Kindergarten through Grade 3: 24 inches above finished floor to top of tray.
2. For Grades 4 through 6: 28 inches above finished floor to top of tray.
3. For Grades 7 and Higher: 36 inches above finished floor to top of tray.

D. Display Rails: Install rails at mounting heights indicated on Drawings, or if not indicated, at height indicated below. Attach to wall surface with fasteners at not more than **16 inches** o.c.

1. Mounting Height: 72 inches above finished floor to top of rail.

3.5 INSTALLATION OF SLIDING VISUAL DISPLAY BOARD ASSEMBLIES

A. Install units at mounting heights indicated on Drawings. Attach to wall framing with fasteners at not more than **16 inches** o.c.

1. Adjust panels to operate smoothly without warp or bind. Lubricate operating hardware as recommended by manufacturer.

3.6 INSTALLATION OF STANDALONE VISUAL DISPLAY RAILS

A. Install rails at mounting heights indicated on Drawings, or if not indicated, at height indicated below. Attach to wall surface with fasteners at not more than **16 inches** o.c.

1. Mounting Height: 72 inches above finished floor to top of rail.

3.7 CLEANING

A. Clean visual display units in accordance with manufacturer's written instructions. Attach one removable cleaning instructions label to visual display unit in each room.

B. Touch up factory-applied finishes to restore damaged or soiled areas.

3.8 PROTECTION

A. Cover and protect visual display units after installation and cleaning.

3.9 DEMONSTRATION

A. Train Owner's maintenance personnel to adjust, operate, and maintain motorized, sliding visual display units.

END OF SECTION 10 11 00

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SECTION 10 14 23 - PANEL SIGNAGE

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Panel signs.
2. Field-applied, vinyl-character signs.

B. Related Requirements:

1. Section 015000 "Temporary Facilities and Controls" for temporary Project identification signs and for temporary informational and directional signs.
2. Section 220553 "Identification for Plumbing Piping and Equipment" for labels, tags, and nameplates for plumbing systems and equipment.
3. Section 230553 "Identification for HVAC Piping and Equipment" for labels, tags, and nameplates for HVAC systems and equipment.
4. Section 260553 "Identification for Electrical Systems" for labels, tags, and nameplates for electrical equipment.
5. Section 265000 "Lighting" for illuminated, self-luminous, and photoluminescent exit sign units.

1.2 DEFINITIONS

A. Accessible: In accordance with the accessibility standard.

B. Illuminated: Illuminated by lighting source integrally constructed as part of the sign unit.

1.3 COORDINATION

A. Furnish templates for placement of sign-anchorage devices embedded in permanent construction by other installers.

B. Furnish templates for placement of electrical service embedded in permanent construction by other installers.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of specified product.

B. Shop Drawings: For panel signs.

1. Include fabrication and installation details and attachments to other work.
2. Show sign mounting heights, locations of supplementary supports to be provided by other installers, and accessories.
3. Show message list, typestyles, graphic elements , including raised characters and Braille, and layout for each sign at least half size.
4. Show locations of electrical service connections.
5. Include diagrams for power, signal, and control wiring.

C. Samples for Initial Selection: For each type of sign assembly, exposed component, and exposed finish.

1. Include representative Samples of available typestyles and graphic symbols.

D. Samples for Verification: For each type of sign assembly showing all components and with the required finish(es), in manufacturer's standard size unless otherwise indicated and as follows:

1. Panel Signs: Full-size Sample.
2. Field-Applied, Vinyl-Character Signs: Full-size Sample of characters on glass.

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3. Variable Component Materials: Full-size Sample of each base material, character (letter, number, and graphic element) in each exposed color and finish not included in Samples above.
4. Exposed Accessories: Full-size Sample of each accessory type.
5. Full-size Samples, if approved, will be returned to Contractor for use in Project.

E. Product Schedule: For panel signs. Use same designations indicated on Drawings or specified.

1.5 INFORMATIONAL SUBMITTALS

A. Evaluation Reports: For post-installed anchors and power-actuated fasteners, from ICC-ES or other qualified testing agency acceptable to authorities having jurisdiction.

B. Qualification Statements: For Installer and manufacturer.

C. Delegated Design Professional Qualifications: For sign structure and anchorage.

D. Sample Warranty: For specified special warranty.

1.6 CLOSEOUT SUBMITTALS

A. Maintenance Data: For signs.

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. Variable Component Materials: 12 replaceable text inserts and interchangeable characters (letters, numbers, and graphic elements) of each type.
2. Tools: One set(s) of specialty tools for assembling signs and replacing variable sign components.

1.8 QUALITY ASSURANCE

A. Installer Qualifications: Manufacturer of products.

1.9 FIELD CONDITIONS

A. Field Measurements: Verify locations of anchorage devices embedded in permanent construction by other installers by field measurements before fabrication, and indicate measurements on Shop Drawings.

1.10 WARRANTY

A. Special Warranty: Manufacturer agrees to repair or replace components of signs that fail in materials or workmanship within specified warranty period.

1. Failures include, but are not limited to, the following:

   a. Deterioration of finishes beyond normal weathering.
   b. Deterioration of embedded graphic image.
   c. Separation or delamination of sheet materials and components.

2. Warranty Period: Five years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Accessibility Standard: Comply with applicable provisions in the ABA standards of the Federal agency having jurisdiction and ICC A117.1.

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2.2 PANEL SIGNS

A. Panel Sign (Types 1-16 as indicated in the drawings): Sign with smooth, uniform surfaces; with message and characters having uniform faces, sharp corners, and precisely formed lines and profiles; and as follows:

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. ACE Sign Systems, Inc.
    b. Advance Corporation
    c. Allen Industries
    d. Allen Markings
    e. APCO Graphics, Inc
    f. ASE, Inc
    g. ASI Sign Systems, Inc
    h. Best Sign Systems, Inc.
    i. Bunting Graphics, Inc
    j. Clarke Systems
    k. Cosco
    l. Diskey Sign Company
    m. Foresight Supersign
    n. Fossil Industries, Inc.
    o. inpro Corporation
    p. Mohawk Sign Systems
    q. Nelson-Harkins Industries
    r. Poblocki Sign Company, LLC
    s. Seton Identification Products; a Brady Corporation company
    t. Signs & Decal Corp
    u. Vista System, LLC
    v. Vomar Products, Inc

2. Solid-Sheet Sign: Acrylic Fiberglass PVC sheet , returns, and back with finish specified in "Surface Finish and Applied Graphics" Subparagraph and as follows:

    a. Thickness: Manufacturer's standard for size of sign.
    b. Surface-Applied, Flat Graphics: Applied vinyl film.
    c. Surface-Applied, Raised Graphics: Applied polymer characters and Braille.
    d. Etched and Filled Graphics: Sign face etched or routed to receive enamel-paint infill.
    e. Inset, Cutout Characters: Sign face routed to receive push-through acrylic graphics flush with the sign panel.

3. Laminated Aluminum-Sheet Sign: Aluminum sheet laminated to both sides of acrylic core sheet .

    a. Composite-Sheet Thickness: Manufacturer's standard for size of sign.
    b. Surface-Applied, Flat Graphics: Applied vinyl film.
    c. Surface-Applied, Raised Graphics: Applied polymer characters and Braille.

4. Laminated-Sheet Sign: Photopolymer face sheet with raised graphics laminated to acrylic backing sheet to produce composite sheet.

    a. Composite-Sheet Thickness: Manufacturer's standard for size of sign.
    b. Surface-Applied, Flat Graphics: Applied vinyl film.
    c. Surface-Applied, Raised Graphics: Applied polymer characters and Braille.

5. Composite Phenolic-Core Sign: Solid phenolic panel core with integral subsurface graphic image covered with integral, polymeric face layer.

    a. Composite-Sheet Thickness: Manufacturer's standard for size of sign.

6. Laminated Polycarbonate-Sheet Sign: Polycarbonate face sheet laminated to each side of phenolic base sheet to produce composite sheet.

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a. Composite-Sheet Thickness: Manufacturer's standard for size of sign.
b. Surface-Applied, Flat Graphics: Applied vinyl film.
c. Surface-Applied, Raised Graphics: Applied polymer characters and Braille.

7. Engraved Plastic-Laminate Sign: Plastic-laminate face laminated to contrasting phenolic core to produce composite sheet.

   a. Composite-Sheet Thickness: Manufacturer's standard for size of sign.
   b. Engraved Graphics: Characters engraved through plastic-laminate face sheet to expose contrasting phenolic core.
   c. Plastic-Laminate Color and Pattern: As selected by Architect from manufacturer's full range.
   d. Core Color: Manufacturer's standard dark color.

8. Sign-Panel Perimeter: Finish edges smooth.

   a. Edge Condition:

      1) Vertical Edges: Square cut.
      2) Horizontal Edges: Square cut.

   b. Corner Condition in Elevation: Square.

9. Mounting: Manufacturer's standard method for substrates indicated with adhesive two-face tape hook-and-loop tape or magnetic tape.
10. Surface Finish and Applied Graphics:

    a. Integral Metal Finish: As selected by Architect from full range of industry finishes.
    b. Integral Aluminum Finish: Anodized color as selected by Architect from full range of industry colors and color densities.
    c. Integral Stainless Steel Finish: As selected by Architect from full range of industry finishes.
    d. Integral Sheet Color: Acrylic sheet with color as selected by Architect from full range of industry colors.
    e. Baked-Enamel or Powder-Coat Finish and Graphics: Manufacturer's standard, in color as selected by Architect from manufacturer's full range.
    f. Painted Finish and Graphics: Manufacturer's standard, factory-applied exterior-grade sign paint, in color as selected by Architect from manufacturer's full range.
    g. Overcoat: Manufacturer's standard baked-on clear coating.

11. Text and Typeface: Accessible raised characters and Braille typeface as selected by Architect from manufacturer's full range. Finish raised characters to contrast with background color, and finish Braille to match background color.
12. Flatness Tolerance: Sign is to remain flat or uniformly curved under installed conditions as indicated on Drawings and within a tolerance of plus or minus 1/16 inch measured diagonally from corner to corner.

2.3 FIELD-APPLIED, VINYL-CHARACTER SIGNS

A. Field-Applied, Vinyl-Character Sign: Prespaced characters die cut from weather-resistant vinyl film with release liner on the back and carrier film on the front for on-site alignment and application.

   1. Vinyl Film Thickness: 3 to 3.5 mils thick.
   2. Size: As indicated on Drawings.
   3. Substrate: As indicated on Drawings.
   4. Text and Font: As indicated on Drawings.

2.4 PANEL-SIGN MATERIALS

A. Aluminum Sheet and Plate: **ASTM B209**, alloy and temper recommended by aluminum producer and finisher for type of use and finish indicated.

B. Aluminum Extrusions: **ASTM B221**, alloy and temper recommended by aluminum producer and finisher for type of use and finish indicated.

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C. Stainless Steel Sheet: ASTM A240/A240M or ASTM A666, Type 304, stretcher-leveled standard of flatness.

D. Acrylic Sheet: ASTM D4802, category as standard with manufacturer for each sign, Type UVF (UV filtering).

E. Fiberglass Sheet: Multiple laminations of glass-fiber-reinforced polyester resin with UV-light stable, colorfast, nonfading, weather- and stain-resistant, colored polyester gel coat, and with manufacturer's standard finish.

F. Polycarbonate Sheet: ASTM C1349, Appendix X1, Type II (coated, mar-resistant, UV-stabilized polycarbonate), with coating on both sides.

G. PVC Sheet: Manufacturer's standard, UV-light stable, PVC plastic.

H. Plastic-Laminate Sheet: ISO 4586-3, Grade HGS.

I. Vinyl Film: UV-resistant vinyl film of nominal thickness indicated, with pressure-sensitive, permanent adhesive on back; die cut to form characters or images as indicated on Drawings and suitable for exterior applications.

J. Paints and Coatings for Sheet Materials: Inks, dyes, and paints that are recommended by manufacturer for optimum adherence to surface and are UV and water resistant for colors and exposure indicated.

2.5 ACCESSORIES

A. Fasteners and Anchors: Manufacturer's standard as required for secure anchorage of signs, noncorrosive and compatible with each material joined, and complying with the following unless otherwise indicated:

1. Use concealed fasteners and anchors unless indicated to be exposed.
2. For exterior exposure, furnish stainless steel devices unless otherwise indicated.
3. Exposed Metal-Fastener Components, General:

    a. Fabricated from same basic metal and finish of fastened metal unless otherwise indicated.

4. Sign Mounting Fasteners:

    a. Concealed Studs: Concealed (blind), threaded studs welded or brazed to back of sign material or screwed into back of sign assembly unless otherwise indicated.
    b. Projecting Studs: Threaded studs with sleeve spacer, welded or brazed to back of sign material or screwed into back of sign assembly, unless otherwise indicated.
    c. Through Fasteners: Exposed metal fasteners matching sign finish, with type of head indicated, and installed in predrilled holes.

5. Inserts: Furnish inserts to be set by other installers into concrete or masonry work.

B. Post-Installed Anchors: Fastener systems with bolts of same basic metal as fastened metal, if visible, unless otherwise indicated; with working capacity greater than or equal to the design load, in accordance with an evaluation report acceptable to authorities having jurisdiction, based on ICC-ES AC01 or ICC-ES AC308 as appropriate for the substrate.

1. Uses: Securing signs with imposed loads to structure.
2. Material for Interior Locations: Carbon-steel components zinc-plated to comply with ASTM B633 or **ASTM F1941**, Class Fe/Zn 5, unless otherwise indicated.

C. Power-Actuated Anchors: Fastener systems with working capacity greater than or equal to the design load, in accordance with an evaluation report acceptable to authorities having jurisdiction, based on ICC-ES AC70.

D. Adhesive: As recommended by sign manufacturer.

E. Two-Face Tape: Manufacturer's standard high-bond, foam-core tape, **0.045 inch** thick, with adhesive

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on both sides.

F. Hook-and-Loop Tape: Manufacturer's standard two-part tape consisting of hooked part on sign back and looped side on mounting surface.

G. Magnetic Tape: Manufacturer's standard magnetic tape with adhesive on one side.

2.6 FABRICATION

A. General: Provide manufacturer's standard sign assemblies in accordance with requirements indicated.

1. Preassemble signs in the shop to greatest extent possible. Disassemble signs and assemblies only as necessary for shipping and handling limitations. Clearly mark units for reassembly and installation; apply markings in locations concealed from view after final assembly.
2. Mill joints to a tight, hairline fit. Form assemblies and joints exposed to weather to resist water penetration and retention.
3. Comply with AWS for recommended practices in welding and brazing. Provide welds and brazes behind finished surfaces without distorting or discoloring exposed side. Clean exposed welded and brazed connections of flux, and dress exposed and contact surfaces.
4. Conceal connections if possible; otherwise, locate connections where they are inconspicuous.
5. Internally brace signs for stability, to meet structural performance loading without oil-canning or other surface deformation, and for securing fasteners.
6. Provide rabbets, lugs, and tabs necessary to assemble components and to attach to existing work. Drill and tap for required fasteners. Use concealed fasteners where possible; use exposed fasteners that match sign finish.

B. Surface-Engraved Graphics: Machine engrave characters and other graphic devices into indicated sign surface to produce precisely formed copy, incised to uniform depth.

1. Engraved Metal: Fill engraved graphics with manufacturer's standard baked enamel.
2. Engraved Opaque Acrylic Sheet: Fill engraved graphics with manufacturer's standard enamel.
3. Face-Engraved Clear Acrylic Sheet: Fill engraved copy with manufacturer's standard enamel. Apply manufacturer's standard opaque background color coating to back face of acrylic sheet.
4. Engraved Plastic Laminate: Engrave through exposed face ply of plastic-laminate sheet to expose contrasting core ply.

C. Subsurface-Applied Graphics: Apply graphics to back face of clear face-sheet material to produce precisely formed image. Image is to be free of rough edges.

D. Subsurface-Engraved Graphics: Reverse engrave back face of clear face-sheet material. Fill resulting copy with manufacturer's standard enamel. Apply opaque manufacturer's standard background color coating over enamel-filled copy.

E. Shop- and Subsurface-Applied Vinyl: Align vinyl film in final position and apply to surface. Firmly press film from the middle outward to obtain good bond without blisters or fishmouths.

F. Signs with Changeable Message Capability: Fabricate signs to allow insertion of changeable messages as follows:

1. For snap-in changeable inserts beneath removable face sheet, furnish one suction or other device to assist in removing face sheet. Furnish initial changeable insert. Furnish two blank inserts for each sign for Owner's use.
2. For slide-in changeable inserts, fabricate slot without burrs or constrictions that inhibit function. Furnish initial changeable insert. Furnish two blank inserts for each sign for Owner's use.
3. For frame to hold changeable sign panel, fabricate frame without burrs or constrictions that inhibit function. Furnish initial sign panel. Subsequent changeable sign panels are by Owner.

2.7 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 not acceptable. Variations in appearance of adjoining components are acceptable if they are within the range of approved Samples

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and are assembled or installed to minimize contrast.

C. Directional Finishes: Run grain with long dimension of each piece and perpendicular to long dimension of finished trim or border surface unless otherwise indicated.

D. Organic, Anodic, and Chemically Produced Finishes: Apply to formed metal after fabrication but before applying contrasting polished finishes on raised features unless otherwise indicated.

2.8 ALUMINUM FINISHES

A. Clear Anodic Finish: AAMA 611, Class I, 0.018 mm or thicker.

B. Color Anodic Finish: AAMA 611, Class I, 0.018 mm or thicker.

C. Baked-Enamel or Powder-Coat Finish: AAMA 2603 except with a minimum dry film thickness of **1.5 mils**. Comply with coating manufacturer's written instructions for cleaning, conversion coating, and applying and baking finish.

2.9 METALLIC-COATED STEEL FINISHES

A. Surface Preparation: Clean surfaces of oil and other contaminants. Use cleaning methods that do not leave residue. After cleaning, apply a conversion coating compatible with the organic coating to be applied over it. Clean welds, mechanical connections, and abraded areas and apply galvanizing repair paint, complying with SSPC-Paint 20, to comply with ASTM A780/A780M.

B. Factory Prime Finish: After cleaning and pretreating, apply an air-dried primer compatible with the organic coating to be applied over it.

C. Baked-Enamel or Powder-Coat Finish: After cleaning and pretreating, apply manufacturer's standard two-coat, baked-on finish consisting of prime coat and thermosetting topcoat to a minimum dry film thickness of **2 mils**.

2.10 STEEL FINISHES

A. Surface Preparation: Remove mill scale and rust, if present, from uncoated steel, and prepare for coating in accordance with coating manufacturer's written instructions.

1. For Baked-Enamel or Powder-Coat Finish: After cleaning, apply a conversion coating compatible with the organic coating to be applied over it.

B. Factory Prime Finish: After surface preparation and pretreatment, apply manufacturer's standard, fast-curing, lead- and chromate-free, universal primer.

C. Baked-Enamel or Powder-Coat Finish: After cleaning and pretreating, apply manufacturer's standard two-coat, baked-on finish consisting of prime coat and thermosetting topcoat to a minimum dry film thickness of **2 mils**.

2.11 STAINLESS STEEL FINISHES

A. Surface Preparation: Remove tool and die marks and stretch lines, or blend into finish.

B. Polished Finishes: Grind and polish surfaces to produce uniform finish, free of cross scratches.

1. When polishing is completed, passivate and rinse surfaces. Remove embedded foreign matter and leave surfaces chemically clean.
2. Directional Satin Finish: No. 4.
3. Dull Satin Finish: No. 6.
4. Reflective, Directional Polish: No. 7.
5. Mirrorlike Reflective, Nondirectional Polish: No. 8.

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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. Verify that sign-support surfaces are within tolerances to accommodate signs without gaps or irregularities between backs of signs and support surfaces unless otherwise indicated.

C. Panel Signs: Verify that anchorage devices embedded in permanent construction are correctly sized and located to accommodate signs.

D. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION OF PANEL SIGNS

A. General: Install signs using mounting methods indicated and in accordance with manufacturer's written instructions.

1. Install signs level, plumb, true to line, and at locations and heights indicated, with sign surfaces free of distortion and other defects in appearance.
2. Install signs so they do not protrude or obstruct in accordance with the accessibility standard.
3. Before installation, verify that sign surfaces are clean and free of materials or debris that would impair installation.
4. Corrosion Protection: Coat concealed surfaces of exterior aluminum in contact with grout, concrete, masonry, wood, or dissimilar metals, with a heavy coat of bituminous paint.

B. Accessible Signage: Install in locations on walls as indicated on Drawings and in accordance with the accessibility standard.

C. Mounting Methods:

1. Adhesive: Clean bond-breaking materials from substrate surface and remove loose debris. Apply linear beads or spots of adhesive symmetrically to back of sign and of suitable quantity to support weight of sign after cure without slippage. Keep adhesive away from edges to prevent adhesive extrusion as sign is applied and to prevent visibility of cured adhesive at sign edges. Place sign in position, and push to engage adhesive. Temporarily support sign in position until adhesive fully sets.
2. Two-Face Tape: Clean bond-breaking materials from substrate surface and remove loose debris. Apply tape strips symmetrically to back of sign and of suitable quantity to support weight of sign without slippage. Keep strips away from edges to prevent visibility at sign edges. Place sign in position, and push to engage tape adhesive.
3. Hook-and-Loop Tape: Clean bond-breaking materials from substrate surface and remove loose debris. Apply sign component of two-part tape strips symmetrically to back of sign and of suitable quantity to support weight of sign without slippage; push to engage tape adhesive. Keep tape strips 0.250 inch away from edges to prevent visibility at sign edges when sign is initially installed or reinstalled. Apply substrate component of tape to substrate in locations aligning with tape on back of sign; push and rub well to fully engage tape adhesive to substrate.
4. Magnetic Tape: Clean bond-breaking materials from substrate surface and remove loose debris. Apply tape strips symmetrically to back of sign and of suitable quantity to support weight of sign without slippage. Keep strips away from edges to prevent visibility at sign edges. Place sign in position.

D. Signs Mounted on Glass: Provide opaque sheet matching sign material and finish onto opposite side of glass to conceal back of sign and two-face tape.

3.3 INSTALLATION OF FIELD-APPLIED, VINYL-CHARACTER SIGNS

A. Install field-applied, vinyl-character signs on a clean and dry substrate. Align sign characters in final position before removing release liner. Remove release liner in stages, and apply and firmly press characters into final position. Press from the middle outward to obtain good bond without blisters or fishmouths. Remove carrier film without disturbing applied vinyl film.

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B. Signs Mounted on Glass: Provide opaque sheet matching sign material and finish onto opposite side of glass to conceal back of sign and two-face tape.

3.4 ADJUSTING

A. Remove and replace damaged or deformed signs and signs that do not comply with specified requirements. Replace signs with damaged or deteriorated finishes or components that cannot be successfully repaired by finish touchup or similar minor repair procedures.

B. Remove temporary protective coverings and strippable films as signs are installed.

3.5 CLEANING

A. On completion of installation, clean exposed surfaces of signs in accordance with manufacturer's written instructions, and touch up minor nicks and abrasions in finish. Maintain signs in a clean condition during construction and protect from damage until acceptance by Owner.

END OF SECTION 10 14 23

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SECTION 10 21 13.13 - METAL TOILET COMPARTMENTS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Metal toilet compartments.

B. Related Requirements:

1. Section 055000 "Metal Fabrications" for supports that attach floor-and-ceiling-anchored compartments to overhead structural system.
2. Section 061000 "Rough Carpentry" for blocking.
3. Section 102800 "Toilet, Bath, and Laundry Accessories" for accessories mounted on toilet compartments.

1.2 COORDINATION

A. Coordinate requirements for blocking, reinforcing, and other supports concealed within wall and ceiling to ensure that toilet compartments can be supported and installed as indicated.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of specified product.

1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for toilet compartments.

B. Shop Drawings:

1. Include plans, elevations, sections, and attachment details.
2. Show locations of cutouts for compartment-mounted toilet accessories.
3. Show locations of reinforcements for compartment-mounted grab bars and locations of blocking for surface-mounted toilet accessories.
4. Show locations of centerlines of toilet fixtures.
5. Show locations of floor drains.
6. Show overhead support or bracing locations.

C. Samples for Initial Selection: Manufacturer's standard color sheets, showing full range of available colors for each type of toilet compartment.

1. Include Samples of hardware and accessories involving material and color selection.

D. Samples for Verification: Actual sample of finished product for each type of toilet compartment, hardware, and accessory.

1. Size: Manufacturers' standard size.

E. Product Schedule: For toilet compartments, prepared by or under the supervision of supplier, detailing location and selected colors for toilet compartment material.

F. Delegated Design Submittals: For grab bars mounted on toilet compartment panels, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

1. Include structural design calculations indicating compliance with specified structural-performance requirements.

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1.4 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For toilet compartments.

1.5 MAINTENANCE MATERIAL SUBMITTALS

A. Extra Stock Material: Furnish extra materials to Owner that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Door Hinges: One hinge(s) with associated fasteners.
2. Latch and Keeper: One latch(es) and keeper(s) with associated fasteners.
3. Door Bumper: One door bumper(s) with associated fasteners.
4. Door Pull: One door pull(s) with associated fasteners.
5. Fasteners: 10 fasteners of each size and type.

1.6 FIELD CONDITIONS

A. Field Measurements: Verify actual locations of toilet fixtures, walls, columns, ceilings, and other construction contiguous with toilet compartments by field measurements, and coordinate before fabrication.

PART 2 - PRODUCTS

2.1 SOURCE LIMITATIONS

A. Obtain metal toilet compartments from single source from single manufacturer.

2.2 PERFORMANCE REQUIREMENTS

A. Surface-Burning Characteristics: Comply with ASTM E84; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.

1. Flame-Spread Index: 25 or less.
2. Smoke-Developed Index: 450 or less.

B. Structural Performance: Where grab bars are mounted on toilet compartments, design panels to comply with the following requirements:

1. Panels are able to withstand a concentrated load on grab bar of at least **250 lbf** applied at any direction and at any point, without deformation of panel.

C. Regulatory Requirements: Comply with applicable provisions in ICC A117.1 for toilet compartments designated as accessible.

2.3 METAL TOILET COMPARTMENTS

A. Metal Toilet Compartments:

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. All American Metal Corp
   b. American Sanitary Partition Corporation
   c. ASI American Specialties, Inc.; ASI Group
   d. Bradley Corporation
   e. Flush Metal Partitions
   f. General Partitions Mfg. Corp
   g. Hadrian Inc.; Zurn Industries, LLC
   h. Metpar Corp

2. Toilet-Enclosure Style: Overhead braced.
3. Entrance-Screen Style: Overhead braced.

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4. Urinal-Screen Style: Wall hung, flat panel.
5. Door, Panel, and Pilaster Construction: Seamless, metal facing sheets pressure laminated to core material; with continuous, interlocking molding strip or lapped-and-formed edge closures; corners secured by welding or clips and exposed welds ground smooth. Exposed surfaces shall be free of pitting, seam marks, roller marks, stains, discolorations, telegraphing of core material, or other imperfections.

    a. Core Material: Manufacturer's standard sound-deadening honeycomb of resin-impregnated kraft paper in thickness required to provide finished thickness of **1 inch** for doors and panels and **1-1/4 inches** for pilasters.
    b. Grab-Bar Reinforcement: Provide concealed internal reinforcement for grab bars mounted on units of size and material adequate for panel to withstand specified structural performance requirements.
    c. Tapping Reinforcement: Provide concealed reinforcement for tapping (threading) at locations where machine screws are used for attaching items to units.

6. Entrance Screen Construction: Matching panel construction.
7. Urinal-Screen Construction:

    a. Flat-Panel Urinal Screen: Matching panel construction.
    b. Integral-Flange, Wall-Hung Urinal Screen: Similar to panel construction, with integral full-height flanges for wall attachment, and maximum **1-1/4 inches** thick.
    c. Wedge-Shaped, Wall-Hung Urinal Screen: Similar to panels, V-shaped, fabricated for concealed wall attachment, and maximum **6 inches** wide at wall and minimum **1 inch** wide at protruding end.

8. Facing Sheets and Closures: Electrolytically coated steel or hot-dip galvanized-steel sheet with nominal base-metal (uncoated) thicknesses as follows:

    a. Pilasters, Braced at Both Ends: Manufacturer's standard thickness, but not less than **0.036 inch**.
    b. Pilasters, Unbraced at One End: Manufacturer's standard thickness, but not less than **0.048 inch**.
    c. Panels: Manufacturer's standard thickness, but not less than 0.030 inch.
    d. Doors: Manufacturer's standard thickness, but not less than **0.030 inch**.
    e. Entrance Screens: Thickness matching panels.
    f. Flat-Panel Urinal Screens: Thickness matching panels.
    g. Integral-Flange, Wall-Hung Urinal Screens: Manufacturer's standard thickness, but not less than **0.030 inch**.
    h. Wedge-Shaped, Wall-Hung Urinal Screens: Manufacturer's standard thickness, but not less than **0.036 inch**.

9. Pilaster Shoes: Formed from stainless steel sheet, not less than **0.031-inch** nominal thickness and **3 inches** high, finished to match hardware.
10. Pilaster Sleeves (Caps): Formed from stainless steel sheet, not less than **0.031-inch** nominal thickness and **3 inches** high, finished to match hardware.
11. Urinal-Screen Post: Manufacturer's standard post design of material matching the thickness and construction of pilasters; with shoe and sleeve (cap) matching that on the pilaster.
12. Brackets (Fittings):

    a. Stirrup Type: Ear or U-brackets; stainless steel.
    b. Full-Height (Continuous) Type: Manufacturer's standard design; stainless steel.

13. Steel Sheet Finish: Immediately after cleaning and pretreating, apply manufacturer's standard baked-on finish, including thermosetting, electrostatically applied, and powder coatings. Apply one color in each room.

    a. Color: As selected by Architect from manufacturer's full range.

2.4 HARDWARE AND ACCESSORIES

A. Door Hardware and Accessories: Manufacturer's operating hardware and accessories.

1. Hinges:

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a. Manufacturer's gravity-actuated, cam-action, self-closing type that can be adjusted to hold doors open at any angle up to 90 degrees, allowing emergency access by lifting door.

1) Material, Gravity-Type Hinge: Stainless steel.

b. Manufacturer's continuous, cam type that swings to a closed or partially open position, allowing emergency access by lifting door.

1) Material, Continuous, Cam-Type Hinge: Stainless steel.

c. Manufacturer's continuous, spring-loaded type, allowing emergency access by lifting door.

1) Material, Continuous, Spring-Loaded Hinge: Stainless steel.

d. Manufacturer's standard hinge.
e. <**Insert requirement**>.

2. Latch and Keeper: Manufacturer's surface-mounted latch unit designed for emergency access and with combination rubber-faced door strike and keeper. Provide units that comply with regulatory requirements for accessibility at toilet enclosures designated as accessible.

a. Material: Stainless steel.

3. Coat Hook: Manufacturer's combination hook and rubber-tipped bumper, sized to prevent inswinging door from hitting compartment-mounted accessories.

a. Material: Stainless steel.

4. Door Bumper: Manufacturer's rubber-tipped bumper at outswinging doors.

a. Material: Manufacturer's standard.

5. Door Pull: Manufacturer's unit at outswinging doors that complies with regulatory requirements for accessibility. Provide units on both sides of doors at toilet enclosures designated as accessible.

a. Material: Stainless steel.

B. Door Hardware and Accessories, Heavy Duty: Manufacturer's heavy-duty institutional operating hardware and accessories.

1. Hinges: Manufacturer's minimum **0.062-inch-** thick, stainless steel gravity-actuated, cam-action, self-closing type that can be adjusted to hold doors open at any angle up to 90 degrees, allowing emergency access by lifting door. Mount with through bolts.
2. Latch and Keeper: Manufacturer's heavy-duty, surface-mounted, cast stainless steel latch unit designed to resist damage due to slamming, with combination rubber-faced door strike and keeper and with provision for emergency access. Provide units that comply with regulatory requirements for accessibility at toilet enclosures designated as accessible. Mount with through bolts.
3. Coat Hook: Manufacturer's heavy-duty, combination cast stainless steel hook and rubber-tipped bumper, sized to prevent inswinging door from hitting compartment-mounted accessories. Mount with through bolts.
4. Door Bumper: Manufacturer's heavy-duty, rubber-tipped, cast stainless steel bumper at outswinging doors. Mount with through bolts.
5. Door Pull: Manufacturer's heavy-duty, cast stainless steel pull at outswinging doors that complies with regulatory requirements for accessibility. Provide units on both sides of doors at toilet enclosures designated as accessible. Mount with through bolts.

C. Overhead Bracing: Manufacturer's standard continuous, extruded-aluminum head rail with antigrip profile and in manufacturer's standard finish.

D. Anchorages and Fasteners: Manufacturer's standard exposed fasteners of stainless steel, finished to match items they are securing, with theft-resistant-type heads. Provide sex-type bolts for through-bolt applications. For concealed anchors, use stainless steel, hot-dip galvanized steel, or other rust-

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resistant, protective-coated steel compatible with related materials.

2.5 MATERIALS

A. Recycled Content of Steel Products: Postconsumer recycled content plus one-half of preconsumer recycled content not less than 25 percent.

B. Recycled Content: Postconsumer recycled content plus one-half of preconsumer recycled content not less than <**Insert number**> percent.

C. Aluminum Castings: ASTM B26/B26M.

D. Aluminum Extrusions: **ASTM B221**.

E. Steel Sheet: Commercial steel sheet for exposed applications; mill phosphatized and selected for smoothness.

1. Electrolytically Zinc Coated: ASTM A879/A879M, **01Z**.
2. Hot-Dip Galvanized: ASTM A653/A653M, either hot-dip galvanized or galvannealed.

F. Stainless Steel Sheet: ASTM A240/A240M or ASTM A666, Type 304, stretcher-leveled standard of flatness.

G. Stainless Steel Castings: ASTM A743/A743M.

H. Zamac: ASTM B86, commercial zinc-alloy die castings, chrome plated.

2.6 FABRICATION

A. Fabricate toilet compartment components to sizes indicated. Coordinate requirements and provide cutouts for through-partition toilet accessories, and solid blocking within panel where required for attachment of toilet accessories.

B. Overhead-Braced Units: Manufacturer's standard corrosion-resistant supports, leveling mechanism, and anchors at pilasters and walls to suit floor and wall conditions. Provide shoes at pilasters to conceal supports and leveling mechanism.

C. Floor-Anchored Units: Manufacturer's standard corrosion-resistant anchoring assemblies at pilasters and walls, with leveling adjustment nuts at pilasters for structural connection to floor. Provide shoes at pilasters to conceal anchorage.

D. Ceiling-Hung Units: Manufacturer's standard corrosion-resistant anchoring assemblies at pilasters and walls, with leveling adjustment nuts at pilasters for connection to structural support above finished ceiling. Provide assemblies that support pilasters from structure without transmitting load to finished ceiling. Provide sleeves (caps) at tops of pilasters to conceal anchorage.

E. Floor-and-Ceiling-Anchored Units: Manufacturer's standard corrosion-resistant anchoring assemblies at pilasters and walls, with leveling adjustment at tops and bottoms of pilasters. Provide shoes and sleeves (caps) at pilasters to conceal anchorage.

F. Urinal-Screen Posts: Manufacturer's standard corrosion-resistant anchoring assemblies at posts and walls, with leveling adjustment at tops and bottoms of posts. Provide shoes and sleeves (caps) at posts to conceal anchorage.

G. Door Size and Swings: Unless otherwise indicated, provide **24-inch-** wide, inswinging doors for standard toilet enclosures and **36-inch-** wide, outswinging doors with a minimum **32-inch-** wide, clear opening for toilet enclosures designated as accessible.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas and conditions, with Installer present, for compliance with requirements for fastening, support, alignment, operating clearances, and other conditions affecting performance of the

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Work.

1. Confirm location and adequacy of blocking and supports required for installation.

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

3.2 INSTALLATION

A. General: Comply with manufacturer's written installation instructions. Install units rigid, straight, level, and plumb. Secure units in position indicated with manufacturer's recommended anchoring devices.

1. Maximum Clearances:

a. Pilasters and Panels or Screens: **1/2 inch**.
b. Panels or Screens and Walls: **1 inch**.

2. Stirrup Brackets: Secure panels or screens to walls and to pilasters with no fewer than two brackets attached near top and bottom of panel.

a. Locate wall brackets so holes for wall anchors occur in masonry or tile joints.
b. Align brackets at pilasters with brackets at walls.

3. Full-Height (Continuous) Brackets: Secure panels or screens to walls and to pilasters with full-height brackets.

a. Locate bracket fasteners so holes for wall anchors occur in masonry or tile joints.
b. Align brackets at pilasters with brackets at walls.

B. Overhead-Braced Units: Secure pilasters to floor and level, plumb, and tighten. Set pilasters with anchors penetrating not less than **1-3/4 inches** into structural floor unless otherwise indicated in manufacturer's written instructions. Secure continuous head rail to each pilaster with no fewer than two fasteners. Hang doors to align tops of doors with tops of panels, and adjust so tops of doors are parallel with overhead brace when doors are in closed position.

C. Floor-Anchored Units: Set pilasters with anchors penetrating not less than **2 inches** into structural floor unless otherwise indicated in manufacturer's written instructions. Level, plumb, and tighten pilasters. Hang doors and adjust so tops of doors are level with tops of pilasters when doors are in closed position.

D. Ceiling-Hung Units: Secure pilasters to supporting structure and level, plumb, and tighten. Hang doors and adjust so bottoms of doors are level with bottoms of pilasters when doors are in closed position.

E. Floor-and-Ceiling-Anchored Units: Secure pilasters to supporting construction and level, plumb, and tighten. Hang doors and adjust so doors are level and aligned with panels when doors are in closed position.

F. Urinal Screens: Attach with anchoring devices to suit supporting structure. Set units level and plumb, rigid, and secured to resist lateral impact.

3.3 ADJUSTING

A. Hardware Adjustment: Adjust and lubricate hardware in accordance with hardware manufacturer's written instructions for proper operation. Set hinges on inswinging doors to hold doors open approximately 30 degrees from closed position when unlatched. Set hinges on outswinging doors to return doors to fully closed position.

END OF SECTION 10 21 13.13

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SECTION 10 26 00 - WALL AND DOOR PROTECTION

PART 1 - GENERAL

1.1 SUMMARY

A. Related Requirements:

1. Section 057300 "Decorative Metal Railings" for metal handrails without plastic bumpers.
2. Section 087100 "Door Hardware" for metal and plastic protective trim units used for armor, kick, mop, and push plates.

1.2 ACTION SUBMITTALS

A. Product Data: For each specified system and assembly, including components and accessories.

1. Include construction details, material descriptions, impact strength, dimensions of individual components and profiles, and finishes.
2. Include fire ratings of units recessed in fire-rated walls and listings for door protection items attached to fire-rated doors.

B. Shop Drawings: For each type of wall and door protection, indicating locations and extent.

1. Include plans, elevations, sections, and attachment details.

C. Samples for Initial Selection: For each type of impact-resistant wall protection unit indicated, in each color and texture specified.

1. Include Samples of accent strips and accessories to verify color selection.

D. Samples for Verification: For each type of exposed finish on the following products, prepared on Samples of size indicated below:

1. Guards: For corner and end wall. **12 inches** long. Include example top caps.

1.3 INFORMATIONAL SUBMITTALS

A. Material Test Reports: For each type of exposed plastic material, by a qualified testing agency.

B. Product Test Reports: For each type of handrail.

C. Sample Warranties: For specified special warranties.

1.4 CLOSEOUT SUBMITTALS

A. Maintenance Data: For each type of wall and door protection product.

1. Include recommended methods and frequency of maintenance for maintaining best condition of plastic covers under anticipated traffic and use conditions. Include precautions against using cleaning materials and methods that may be detrimental to finishes and performance.

1.5 MAINTENANCE MATERIAL SUBMITTALS

A. Extra Stock Material: Furnish extra materials , from the same production run, to Owner that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Corner-Guard Covers: Full-size plastic covers of maximum length equal to 2 percent of each type, color, and texture of cover installed, but no fewer than two, 48-inch- long units.
2. Mounting and Accessory Components: Amounts proportional to quantities of extra materials. Package mounting and accessory components with each extra material.

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1.6 DELIVERY, STORAGE, AND HANDLING

A. Store wall and door protection in original undamaged packages and containers inside well-ventilated area protected from weather, moisture, soiling, extreme temperatures, and humidity.

1. Maintain room temperature within storage area at not less than **70 deg F** during the period plastic materials are stored.
2. Keep plastic materials out of direct sunlight.
3. Store plastic wall and door protection components for a minimum of 72 hours, or until plastic material attains a minimum room temperature of **70 deg F**.

   a. Store corner-guard covers in a vertical position.
   b. Store wall-guard covers in a horizontal position.

1.7 WARRANTY

A. Special Warranty: Manufacturer agrees to repair or replace components of wall and door protection units that fail in materials or workmanship within specified warranty period.

1. Failures include, but are not limited to, the following:

   a. Structural failures, including detachment of components from each other or from the substrates, delamination, and permanent deformation beyond normal use.
   b. Deterioration of metals, metal finishes, plastics, and other materials beyond normal use.

2. Warranty Period: Five years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 SOURCE LIMITATIONS

A. Obtain wall and door protection products from single source from single manufacturer.

2.2 PERFORMANCE REQUIREMENTS

A. Surface-Burning Characteristics: Comply with ASTM E84 or UL 723; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.

1. Flame-Spread Index: 25 or less.
2. Smoke-Developed Index: 450 or less.

B. Regulatory Requirements: Comply with applicable provisions in the United States Access Board's ADA-ABA Accessibility Guidelines and ICC A117.1.

C. Structural Performance: Handrails, including attachment to building construction, must withstand the effects of gravity loads and the following loads and stresses within limits and under conditions indicated:

1. Uniform load of 50 lbf/ft. applied in any direction.
2. Concentrated load of **200 lbf** applied in any direction.
3. Uniform and concentrated loads need not be assumed to act concurrently.

2.3 CORNER GUARDS

A. Surface-Mounted Corner Guards:

1. Surface-Mounted, Metal Corner Guards:

   a. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

      1) Babcock-Davis

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2) Boston Group USA
3) Burns Manufacturing Incorporated
4) Construction Specialties, Inc.
5) inpro Corporation
6) JL Industries; Activar Construction Products Group, Inc.
7) Koroseal Interior Products, LLC
8) Pawling Corporation
9) WallGuard.com
10) Wallprotex

b. Type: Fabricated as one piece from formed or extruded metal with formed edges; with 90- or 135-degree turn to match wall condition
c. Material:

1) Stainless steel sheet, Type 304.

a) Thickness: Minimum 0.0625 inch.
b) Finish: Directional satin, No. 4.

2) Extruded aluminum, minimum **0.0625 inch** thick, with clear anodic finish.

d. Wing Size: Nominal 2-1/2 by 2-1/2 inches.
e. Corner Radius: 1/8 inch.
f. Mounting: Flat-head, countersunk screws through factory-drilled mounting holes Adhesive.

2.4 END-WALL GUARDS

A. Surface-Mounted End-Wall Guards:

1. Surface-Mounted, Metal, End-Wall Guards:

a. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1) American Floor Products Company, Inc
2) WallGuard.com

b. Type: Fabricated from one-piece, formed or extruded metal that covers entire end of wall; with formed edges.
c. Material:

1) Stainless steel sheet, Type 304.

a) Thickness: Minimum 0.0625 inch.
b) Finish: Directional satin, No. 4.

2) Extruded aluminum, minimum **0.0625 inch** thick, with clear anodic finish.
3) Brass sheet, minimum **0.0500 inch** thick, with fine satin finish.

d. Wing Size: Nominal 2-1/2 by 2-1/2 inches.
e. Corner Radius: 1/8 inch.
f. Mounting: Flat-head, countersunk screws through factory-drilled mounting holes Adhesive.

2.5 MATERIALS

A. Plastic Materials: Chemical- and stain-resistant, high-impact-resistant plastic with integral color throughout; extruded and sheet material as required; thickness as indicated.

B. Polycarbonate Plastic Sheet: ASTM D6098, S-PC01, Class 1 or Class 2, abrasion resistant; with a minimum impact-resistance rating of **15 ft.-lbf/in.** of notch when tested in accordance with ASTM D256, Test Method A.

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C. Solid Wood: Clear hardwood lumber of species indicated, free of appearance defects, and selected for compatible grain and color.

D. Fasteners: Aluminum, nonmagnetic stainless steel, or other noncorrosive metal screws, bolts, and other fasteners compatible with items being fastened. Use security-type fasteners where exposed to view.

E. Adhesive: As recommended in writing by protection product manufacturer.

2.6 FABRICATION OF WALL AND DOOR PROTECTION

A. Fabricate wall and door protection in accordance with requirements indicated for design, performance, dimensions, and member sizes, including thicknesses of components.

B. Curved Panels: Preform curved, semirigid, abuse-resistant sheet wall covering in factory for radius and sheet thickness as follows:

1. Sheet Thickness of 0.040 Inch (1.0 mm): **24-inch** radius.
2. Sheet Thickness of 0.060 Inch (1.5 mm): **36-inch** radius.

C. Factory Assembly: Assemble components in factory to greatest extent possible to minimize field assembly. Disassemble only as necessary for shipping and handling.

D. Quality: Fabricate components with uniformly tight seams and joints and with exposed edges rolled. Provide surfaces free of wrinkles, chips, dents, uneven coloration, and other imperfections. Fabricate members and fittings to produce flush, smooth, and rigid hairline joints.

E. Wood Handrails: Miter corners and ends of wood handrails for returns.

2.7 FINISHES

A. Protect 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 substrates and wall areas, with Installer present, for compliance with requirements for installation tolerances , fire rating, and other conditions affecting performance of the Work.

B. Examine walls to which wall and door protection will be attached for blocking, grounds, and other solid backing that have been installed in the locations required for secure attachment of support fasteners.

1. For wall and door protection attached with adhesive, verify compatibility with and suitability of substrates, including compatibility with existing finishes or primers.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Complete finishing operations, including painting, before installing wall and door protection.

B. Before installation, clean substrate to remove dust, debris, and loose particles.

3.3 INSTALLATION OF WALL AND DOOR PROTECTION

A. Install wall and door protection in accordance with manufacturer's written instructions, level, plumb, and true to line without distortions. Do not use materials with chips, cracks, voids, stains, or other

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defects that might be visible in the finished Work.

B. Mounting Heights: Install wall and door protection in locations and at mounting heights indicated on Drawings.

C. Accessories: Provide splices, mounting hardware, anchors, trim, joint moldings, and other accessories required for a complete installation.

1. Provide anchoring devices and suitable locations to withstand imposed loads.
2. Where splices occur in horizontal runs of more than **20 ft.**, splice aluminum retainers and plastic covers at different locations along the run, but no closer than **12 inches** apart.
3. Adjust end caps as required to ensure tight seams.

D. Abuse-Resistant Wall Coverings: Install top and edge moldings, corners, and divider bars as required for a complete installation.

E. Door-Frame Protectors: Install on both door jambs.

3.4 CLEANING

A. Immediately after completion of installation, clean plastic covers and accessories using a standard ammonia-based household cleaning agent.

B. Remove excess adhesive using methods and materials recommended in writing by manufacturer.

END OF SECTION 10 26 00

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SECTION 10 28 00 - TOILET, BATH, AND LAUNDRY ACCESSORIES

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Public-use washroom accessories.
2. Underlavatory guards.
3. Custodial accessories.

B. Related Requirements:

1. Section 088300 "Mirrors" for frameless mirrors.
2. Section 093013 "Ceramic Tiling" for ceramic toilet and bath accessories.

1.2 COORDINATION

A. Coordinate accessory locations with other work to prevent interference with clearances required for access by people with disabilities, and for proper installation, adjustment, operation, cleaning, and servicing of accessories.

B. Deliver inserts and anchoring devices set into concrete or masonry as required to prevent delaying the Work.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of specified product.

1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes.
2. Include anchoring and mounting requirements, including requirements for cutouts in other work and substrate preparation.
3. Include electrical characteristics.

B. Samples: For each exposed product and for each finish specified, full size.

1. Approved full-size Samples will be returned and may be used in the Work.

C. Product Schedule: Indicating types, quantities, sizes, and installation locations by room of each accessory required.

1. Identify locations using room designations indicated.
2. Identify accessories using designations indicated.

1.4 INFORMATIONAL SUBMITTALS

A. Sample Warranty: For manufacturer's special warranties.

1.5 CLOSEOUT SUBMITTALS

A. Maintenance Data: For accessories to include in maintenance manuals.

1.6 WARRANTY

A. Manufacturer's Special Warranty for Mirrors: Manufacturer agrees to repair or replace mirrors that fail in materials or workmanship within specified warranty period.

1. Failures include, but are not limited to, visible silver spoilage defects.

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2. Warranty Period: 15 years from date of Substantial Completion.

B. Manufacturer's Special Warranty for Hand Dryers: Manufacturer agrees to repair or replace hand dryers that fail in materials or workmanship within specified warranty period.

1. Warranty Period: 10 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 OWNER-FURNISHED MATERIALS

A. Owner-Furnished Materials: -.

1. The owner may provide some of the items listed in this section through their existing vendor. The Contractor shall provide all items listed in this section regardless of whether or not they are indicated in the drawings at all restroom and sink locations. Clarify locations with architect prior to installation. Contractor to include line item in budget for all accessories which may be applied as a credit if one or more is to be provided by the Owner's vendor.

2.2 PERFORMANCE REQUIREMENTS

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

B. Structural Performance: Design accessories and fasteners to comply with the following requirements:

1. Grab Bars: Installed units are able to resist **250 lbf** minimum concentrated load applied in any direction and at any point.

2.3 PUBLIC-USE WASHROOM ACCESSORIES

A. Source Limitations: Obtain public-use washroom accessories from single source from single manufacturer.

B. Toilet Tissue (Roll) Dispenser:

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. ASI-American Specialties, Inc.
   b. Bobrick Washroom Equipment, Inc
   c. Bradley Corporation
   d. Gamco Commercial Restroom Accessories; Bobrick Washroom Equipment, Inc.

2. Description: Roll-in-reserve dispenser with hinged front secured with tumbler lockset.
3. Mounting: Surface mounted.
4. Operation: Noncontrol delivery with standard spindle.
5. Capacity: Designed for 4-1/2- or 5-inch- diameter tissue rolls.
6. Material and Finish: Stainless steel, ASTM A480/A480M No. 4 finish (satin).

C. Automatic Paper Towel (Roll) Dispenser:

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. ASI-American Specialties, Inc.
   b. Bobrick Washroom Equipment, Inc
   c. Bradley Corporation
   d. Gamco Commercial Restroom Accessories; Bobrick Washroom Equipment, Inc.

2. Description: Automatic motion-sensing mechanism with user-adjustable delay and paper towel length; battery powered.
3. Mounting: Surface mounted.
4. Minimum Capacity: 8-inch- wide, 800-foot- long roll.

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5. Material and Finish: Stainless steel, ASTM A480/A480M No. 4 finish (satin).
6. Lockset: Tumbler type.

D. Warm-Air Hand Dryer:

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. American Dryer, Inc
    b. ASI-American Specialties, Inc.
    c. Bobrick Washroom Equipment, Inc
    d. Bradley Corporation
    e. Excel Dryer Inc.
    f. Gamco Commercial Restroom Accessories; Bobrick Washroom Equipment, Inc.
    g. Saniflow Corporation; Mediclinics S.A.
    h. Sloan Valve Company
    i. Tubular Specialties Manufacturing, Inc.
    j. World Dryer

2. Description: Standard-speed, warm-air hand dryer.
3. Mounting: Surface mounted.

    a. Protrusion Limit: Installed unit protrudes maximum **4 inches** from wall surface.

4. Operation: Infrared-sensor activated with timed power cutoff switch.

    a. Automatic Shutoff: At 40 seconds.

5. Maximum Sound Level: 63 dB.
6. Cover Material and Finish: Stainless steel, ASTM A480/A480M No. 4 finish (satin).
7. Electrical Requirements: See electrical drawings for service requirements.

E. Soap Dispenser:

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. Aluids; Krome USA Inc.
    b. ASI-American Specialties, Inc.
    c. Bobrick Washroom Equipment, Inc
    d. Bradley Corporation
    e. Brey-Krause Manufacturing Co.
    f. Gamco Commercial Restroom Accessories; Bobrick Washroom Equipment, Inc.
    g. Seachrome Corporation
    h. Tubular Specialties Manufacturing, Inc.

2. Description: Designed for manual operation and dispensing soap in liquid or lotion form.
3. Mounting: Horizontally oriented, surface mounted.
4. Capacity: Per manufacturer.
5. Materials: Per manufacturer.
6. Lockset: Tumbler type.
7. Refill Indicator: Window type.

F. Grab Bars:

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. ASI-American Specialties, Inc.
    b. Bobrick Washroom Equipment, Inc
    c. Bradley Corporation
    d. Gamco Commercial Restroom Accessories; Bobrick Washroom Equipment, Inc.
    e. Tubular Specialties Manufacturing, Inc.

2. Mounting: Flanges with concealed fasteners.

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3. Material: Stainless steel, **0.05 inch** thick.

    a. Finish: Smooth, ASTM A480/A480M No. 4 finish (satin) on ends and slip-resistant texture in grip area.

4. OD: 1-1/2 inches.
5. Configuration and Length: As indicated on Drawings.

G. Sanitary-Napkin Disposal Unit:

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. ASI-American Specialties, Inc.
    b. Bobrick Washroom Equipment, Inc
    c. Bradley Corporation
    d. Gamco Commercial Restroom Accessories; Bobrick Washroom Equipment, Inc.

2. Mounting: Surface mounted.
3. Door or Cover: Self-closing, disposal-opening cover and hinged face panel with tumbler lockset.
4. Receptacle: Removable.
5. Material and Finish: Stainless steel, ASTM A480/A480M No. 4 finish (satin).

H. Seat-Cover Dispenser:

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. ASI-American Specialties, Inc.
    b. Bobrick Washroom Equipment, Inc
    c. Bradley Corporation

2. Mounting: Surface mounted.
3. Minimum Capacity: 250 seat covers.
4. Exposed Material and Finish: Stainless steel, ASTM A480/A480M No. 4 finish (satin).
5. Lockset: Tumbler type.

I. Mirror Unit:

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. ASI-American Specialties, Inc.
    b. Bobrick Washroom Equipment, Inc
    c. Bradley Corporation
    d. Gamco Commercial Restroom Accessories; Bobrick Washroom Equipment, Inc.

2. Frame: Stainless steel angle, 0.05 inch thick.

    a. Corners: Manufacturer's standard.

3. Size: As indicated on Drawings.
4. Hangers: Manufacturer's standard rigid, tamper and theft resistant.

J. Hook:

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. ASI-American Specialties, Inc.
    b. Bobrick Washroom Equipment, Inc
    c. Bradley Corporation
    d. Gamco Commercial Restroom Accessories; Bobrick Washroom Equipment, Inc.

2. Description: Double-prong unit.

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3. Mounting: Exposed.
4. Material and Finish: Stainless steel, ASTM A480/A480M No. 4 finish (satin).

2.4 CHILDCARE ACCESSORIES

A. Source Limitations: Obtain childcare accessories from single source from single manufacturer.

2.5 UNDERLAVATORY GUARDS

A. Underlavatory Guard:

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. Buckaroos, Inc.
   b. Plumberex Specialty Products, Inc.
   c. ProFlo; a Ferguson Enterprises, Inc. brand
   d. Truebro; IPS Corporation

2. Description: Insulating pipe covering for supply and drain piping assemblies that prevents direct contact with and burns from piping; allow service access without removing coverings.
3. Material and Finish: Antimicrobial, molded plastic, white.

2.6 CUSTODIAL ACCESSORIES

A. Source Limitations: Obtain custodial accessories from single source from single manufacturer.

B. Custodial Utility Shelf:

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. ASI-American Specialties, Inc.
   b. Bobrick Washroom Equipment, Inc
   c. Bradley Corporation
   d. Gamco Commercial Restroom Accessories; Bobrick Washroom Equipment, Inc.

2. Description: With exposed edges turned down not less than **1/2 inch** and supported by two triangular brackets welded to shelf underside.
3. Size: 16 inches long by 6 inches deep.
4. Material and Finish: Not less than nominal **0.05-inch-** thick stainless steel, ASTM A480/A480M No. 4 finish (satin).

C. Custodial Mop and Broom Holder:

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. ASI-American Specialties, Inc.
   b. Bobrick Washroom Equipment, Inc
   c. Bradley Corporation
   d. Gamco Commercial Restroom Accessories; Bobrick Washroom Equipment, Inc.

2. Description: Unit with shelf, hooks, holders, and rod suspended beneath shelf.
3. Length: 36 inches.
4. Hooks: Four.
5. Mop/Broom Holders: Three, spring-loaded, rubber hat, cam type.
6. Material and Finish: Stainless steel, ASTM A480/A480M No. 4 finish (satin).

   a. Rod: Approximately **1/4-inch-** diameter stainless steel.

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2.7 MATERIALS

A. Stainless Steel: ASTM A240/A240M or ASTM A666, Type 304, **0.031-inch-** minimum nominal thickness unless otherwise indicated.

B. Brass: ASTM B19, flat products; ASTM B16/B16M, rods, shapes, forgings, and flat products with finished edges; or ASTM B30, castings.

C. Steel Sheet: ASTM A1008/A1008M, Designation CS (cold rolled, commercial steel), **0.036-inch-** minimum nominal thickness.

D. Galvanized-Steel Sheet: ASTM A653/A653M, with **G60** hot-dip zinc coating.

E. Galvanized-Steel Mounting Devices: ASTM A153/A153M, hot-dip galvanized after fabrication.

F. Fasteners: Screws, bolts, and other devices of same material as accessory unit, unless otherwise recommended by manufacturer in writing or specified in this Section, and tamper and theft resistant where exposed, and of stainless or galvanized steel where concealed.

G. Chrome Plating: ASTM B456, Service Condition Number SC 2 (moderate service).

H. Mirrors: ASTM C1503, Mirror Glazing Quality, clear-glass mirrors, nominal 6.0 mm thick.

2.8 FABRICATION

A. General: Fabricate units with tight seams and joints, and exposed edges rolled. Hang doors and access panels with full-length, continuous hinges. Equip units for concealed anchorage and with corrosion-resistant backing plates.

B. Keys: Provide universal keys for internal access to accessories for servicing and resupplying. Provide minimum of six keys to Owner's representative.

PART 3 - EXECUTION

3.1 INSTALLATION OF TOILET, BATH, AND LAUNDRY ACCESSORIES

A. Install accessories in accordance with manufacturers' written instructions, using fasteners appropriate to substrate indicated and recommended by unit manufacturer in writing. Install units level, plumb, and firmly anchored in locations and at heights indicated.

1. Remove temporary labels and protective coatings.

B. Grab Bars: Install to comply with specified structural-performance requirements.

C. Folding Shower Seats: Install to comply with specified structural-performance requirements.

D. Private-Use Folding Shower Seats: Install to comply with specified structural-performance requirements.

3.2 ADJUSTING

A. Adjust accessories for unencumbered, smooth operation. Replace damaged or defective items.

3.3 CLEANING

A. Clean and polish exposed surfaces in accordance with manufacturer's written instructions.

END OF SECTION 10 28 00

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SECTION 10 44 13 - FIRE PROTECTION CABINETS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Fire-protection cabinet.

B. Related Requirements:

1. Section 104416 "Fire Extinguishers" for portable, hand-carried fire extinguishers accommodated by fire-protection cabinets.

1.2 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1. Review methods and procedures related to fire-protection cabinets, including, but not limited to, the following:

a. Schedules and coordination requirements.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of specified product.

1. Show door hardware, cabinet type, trim style, and panel style. Include roughing-in dimensions and details showing recessed-, semirecessed-, or surface-mounting method and relationships of box and trim to surrounding construction.
2. Show location of knockouts for hose valves.

B. Shop Drawings: For fire-protection cabinets.

1. Include plans, elevations, sections, and attachment details.

C. Samples for Initial Selection: For each type of exposed finish required.

D. Samples for Verification: For each type of exposed finish required, prepared on Samples **6 by 6 inches** square.

E. Product Schedule: For fire-protection cabinets. Indicate whether recessed, semirecessed, or surface mounted. Coordinate final fire-protection cabinet schedule with fire-extinguisher schedule to ensure proper fit and function.

1.4 CLOSEOUT SUBMITTALS

A. Maintenance Data: For fire-protection cabinets.

1.5 COORDINATION

A. Coordinate size of fire-protection cabinets to ensure that type and capacity of fire extinguishers indicated are accommodated.

B. Coordinate sizes and locations of fire-protection cabinets with wall depths.

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PART 2 - PRODUCTS

2.1 SOURCE LIMITATIONS

A. Obtain fire-protection cabinets, accessories, and fire extinguishers from single source from single manufacturer.

2.2 PERFORMANCE REQUIREMENTS

A. Fire-Rated Fire-Protection Cabinets: Listed and labeled to comply with requirements in ASTM E814 for fire-resistance rating of walls where they are installed.

2.3 FIRE-PROTECTION CABINETS

A. Fire-Protection Cabinet:

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. Babcock-Davis
    b. Croker; a Division of Morris Group International
    c. Guardian Fire Equipment, Inc
    d. JL Industries; Activar Construction Products Group, Inc.
    e. Larsen's Manufacturing Company
    f. Modern Metal Products
    g. MOON American, Inc.
    h. Nystrom, Inc.
    i. Potter Roemer LLC; a Division of Morris Group International
    j. Strike First Corporation of America

2. Fire-Protection Cabinet Type: Suitable for fire extinguisher.
3. Cabinet Construction: Nonrated.

    a. Fire-Rated Cabinets: Construct fire-rated cabinets with double walls fabricated from **0.043-inch-** thick cold-rolled steel sheet lined with minimum **5/8-inch-** thick fire-barrier material. Provide factory-drilled mounting holes.

4. Cabinet Material: Stainless steel sheet.

    a. Shelf: Same metal and finish as cabinet.

5. Recessed Cabinet:

    a. Trimless with Concealed Flange: Surface of surrounding wall finishes flush with exterior finished surface of cabinet frame and door, without overlapping trim attached to cabinet. Provide recessed flange, of same material as box, attached to box, to act as drywall bead.
    b. Trimless with Hidden Flange: Flange of same metal and finish as box overlaps surrounding wall finish and is concealed from view by an overlapping door.
    c. Exposed Flat Trim: One-piece combination trim and perimeter door frame overlapping surrounding wall surface, with exposed trim face and wall return at outer edge (backbend).

6. Semirecessed Cabinet: One-piece combination trim and perimeter door frame overlapping surrounding wall surface, with exposed trim face and wall return at outer edge (backbend).

    a. Square-Edge Trim: **1-1/4- to 1-1/2-inch** backbend depth.
    b. Rolled-Edge Trim: 2-1/2-inch backbend depth.

7. Surface-Mounted Cabinet: Cabinet box fully exposed and mounted directly on wall with no trim.
8. Cabinet Trim Material: Stainless steel sheet.
9. Door Material: Stainless steel sheet.
10. Door Style: Fully glazed panel with frame.

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11. Door Glazing: Tempered break glass.

    a. Acrylic Sheet Color:

        1) Clear transparent acrylic sheet.

12. Door Hardware: Manufacturer's standard door-operating hardware of proper type for cabinet type, trim style, and door material and style indicated.

    a. Provide manufacturer's standard.
    b. Provide manufacturer's standard hinge, permitting door to open 180 degrees.

13. Accessories:

    a. Mounting Bracket: Manufacturer's standard steel, designed to secure fire extinguisher to fire-protection cabinet, of sizes required for types and capacities of fire extinguishers indicated, with plated or baked-enamel finish.
    b. Break-Glass Strike: Manufacturer's standard metal strike, complete with chain and mounting clip, secured to cabinet.
    c. Break-Glass Door Handle: Manufacturer's standard, integral to glass with the words "PULL TO BREAK GLASS" applied to handle.
    d. Lettered Door Handle: One-piece, cast-iron door handle with the word "FIRE" embossed into face.
    e. Door Lock: Cam lock that allows door to be opened during emergency by pulling sharply on door handle.
    f. Identification: Lettering complying with authorities having jurisdiction for letter style, size, spacing, and location. Locate as indicated.

        1) Identify fire extinguisher in fire-protection cabinet with the words " FIRE EXTINGUISHER."

            a) Location: Applied to cabinet door.
            b) Application Process: Silk-screened.
            c) Lettering Color: Red.
            d) Orientation: Horizontal.

    g. Alarm: Manufacturer's standard alarm that actuates when fire-protection cabinet door is opened and that is powered by batteries.

14. Materials:

    a. Stainless Steel: ASTM A240/A240M or ASTM A666, Type 304.

        1) Finish: ASTM A480/A480M No. 4 directional satin finish,.

    b. Tempered Break Glass: ASTM C1048, Kind FT, Condition A, Type I, Quality q3, 1.5 mm thick.
    c. Transparent Acrylic Sheet: ASTM D4802, Category A-1 (cell-cast sheet), 3 mm thick, with Finish 1 (smooth or polished).

2.4 FABRICATION

A. Fire-Protection Cabinets: Provide manufacturer's standard box (tub) with trim, frame, door, and hardware to suit cabinet type, trim style, and door style indicated.

    1. Weld joints and grind smooth.
    2. Miter corners and grind smooth.
    3. Provide factory-drilled mounting holes.
    4. Prepare doors and frames to receive locks.
    5. Install door locks at factory.

B. Cabinet Doors: Fabricate doors according to manufacturer's standards, from materials indicated and coordinated with cabinet types and trim styles.

    1. Fabricate door frames with tubular stiles and rails and hollow-metal design, minimum **1/2 inch**

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thick.
2. Fabricate door frames of one-piece construction with edges flanged.
3. Miter and weld perimeter door frames and grind smooth.

C. Cabinet Trim: Fabricate cabinet trim in one piece with corners mitered, welded, and ground smooth.

2.5 GENERAL FINISH REQUIREMENTS

A. Comply with NAAMM AMP 500for recommendations for applying and designating finishes.

B. Protect mechanical finishes on exposed surfaces of fire-protection cabinets from damage by applying a strippable, temporary protective covering before shipping.

C. Finish fire-protection cabinets after assembly.

D. 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 walls and partitions for suitable framing depth and blocking where recessed and semirecessed cabinets will be installed.

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

3.2 PREPARATION

A. Prepare recesses for recessed and semirecessed fire-protection cabinets as required by type and size of cabinet and trim style.

3.3 INSTALLATION OF FIRE-PROTECTION CABINETS

A. General: Install fire-protection cabinets in locations and at mounting heights indicated or, if not indicated, at heights acceptable to authorities having jurisdiction.

1. Fire-Protection Cabinet Mounting Height: 42 inches above finished floor to top of fire extinguisher.

B. Fire-Protection Cabinets: Fasten cabinets to structure, square and plumb.

1. Unless otherwise indicated, provide recessed fire-protection cabinets. If wall thickness is inadequate for recessed cabinets, provide semirecessed fire-protection cabinets.
2. Provide inside latch and lock for break-glass panels.
3. Fasten mounting brackets to inside surface of fire-protection cabinets, square and plumb.
4. Fire-Rated Cabinets:

   a. Install cabinet with not more than **1/16-inch** tolerance between pipe OD and knockout OD. Center pipe within knockout.
   b. Seal through penetrations with firestopping sealant as specified in Section 078413 "Penetration Firestopping."

C. Identification:

1. Apply decals at locations indicated.
2. Apply decals on field-painted fire-protection cabinets after painting is complete.

3.4 ADJUSTING

A. Remove temporary protective coverings and strippable films, if any, as fire-protection cabinets are

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installed unless otherwise indicated in manufacturer's written installation instructions.

B. Adjust fire-protection cabinet doors to operate easily without binding. Verify that integral locking devices operate properly.

3.5 CLEANING

A. On completion of fire-protection cabinet installation, clean interior and exterior surfaces as recommended by manufacturer.

B. Touch up marred finishes, or replace fire-protection cabinets that cannot be restored to factory-finished appearance. Use only materials and procedures recommended or furnished by fire-protection cabinet and mounting bracket manufacturers.

C. Replace fire-protection cabinets that have been damaged or have deteriorated beyond successful repair by finish touchup or similar minor repair procedures.

END OF SECTION 10 44 13

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SECTION 10 44 16 - FIRE EXTINGUISHERS

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes portable, hand-carried fire extinguishers and mounting brackets for fire extinguishers.

B. Related Requirements:

1. Section 104413 "Fire Protection Cabinets."

1.2 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1. Review methods and procedures related to fire extinguishers including, but not limited to, the following:

a. Schedules and coordination requirements.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product. Include rating and classification, material descriptions, dimensions of individual components and profiles, and finishes for fire extinguisher and mounting brackets.

B. Product Schedule: For fire extinguishers. Coordinate final fire-extinguisher schedule with fire-protection cabinet schedule to ensure proper fit and function.

1.4 INFORMATIONAL SUBMITTALS

A. Warranty: Sample of special warranty.

1.5 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For fire extinguishers to include in maintenance manuals.

1.6 COORDINATION

A. Coordinate type and capacity of fire extinguishers with fire-protection cabinets to ensure fit and function.

1.7 WARRANTY

A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace fire extinguishers that fail in materials or workmanship within specified warranty period.

1. Failures include, but are not limited to, the following:

a. Failure of hydrostatic test according to NFPA 10 when testing interval required by NFPA 10 is within the warranty period.
b. Faulty operation of valves or release levers.

2. Warranty Period: Six years from date of Substantial Completion.

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PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. NFPA Compliance: Fabricate and label fire extinguishers to comply with NFPA 10, "Portable Fire Extinguishers."

B. Fire Extinguishers: Listed and labeled for type, rating, and classification by an independent testing agency acceptable to authorities having jurisdiction.

1. Provide fire extinguishers approved, listed, and labeled by FM Global.

2.2 PORTABLE, HAND-CARRIED FIRE EXTINGUISHERS

A. Fire Extinguishers: Type, size, and capacity for each fire-protection cabinet and mounting bracket indicated.

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. Amerex Corporation
b. Babcock-Davis
c. Badger Fire Protection; a Carrier company
d. Buckeye Fire Equipment Company
e. Croker; a Division of Morris Group International
f. Guardian Fire Equipment, Inc
g. JL Industries; Activar Construction Products Group, Inc.
h. Johnson Controls, Inc.
i. Kidde; Carrier Global Corporation
j. Larsen's Manufacturing Company
k. MOON American, Inc.
l. Nystrom, Inc.
m. Potter Roemer LLC; a Division of Morris Group International
n. Pyro-Chem; brand of Johnson Controls International plc, Building Solutions North America
o. Strike First Corporation of America

2. Source Limitations: Obtain fire extinguishers, fire-protection cabinets, and accessories, from single source from single manufacturer.
3. Valves: Manufacturer's standard.
4. Handles and Levers: Manufacturer's standard.
5. Instruction Labels: Include pictorial marking system complying with NFPA 10, Appendix B , and bar coding for documenting fire-extinguisher location, inspections, maintenance, and recharging.

B. Multipurpose Dry-Chemical Type in Steel Container (-) <**Insert Drawing Designation**>: UL-rated 2-A:10-B:C, 5-lb nominal capacity, with monoammonium phosphate-based dry chemical in enameled-steel container.

2.3 MOUNTING BRACKETS

A. Mounting Brackets: Manufacturer's standard galvanized steel, designed to secure fire extinguisher to wall or structure, of sizes required for types and capacities of fire extinguishers indicated, with plated or black baked-enamel finish.

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. Amerex Corporation
b. Babcock-Davis
c. Badger Fire Protection; a Carrier company
d. Buckeye Fire Equipment Company
e. Croker; a Division of Morris Group International

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f. Guardian Fire Equipment, Inc
g. JL Industries; Activar Construction Products Group, Inc.
h. Johnson Controls, Inc.
i. Kidde; Carrier Global Corporation
j. Larsen's Manufacturing Company
k. Nystrom, Inc.
l. Potter Roemer LLC; a Division of Morris Group International
m. Pyro-Chem; brand of Johnson Controls International plc, Building Solutions North America
n. Strike First Corporation of America

2. Source Limitations: Obtain mounting brackets and fire extinguishers from single source from single manufacturer.

B. Identification: Lettering complying with authorities having jurisdiction for letter style, size, spacing, and location. Locate as indicated by Architect.

1. Identify bracket-mounted fire extinguishers with the words "FIRE EXTINGUISHER" in red letter decals applied to mounting surface.

a. Orientation: Vertical.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine fire extinguishers for proper charging and tagging.

1. Remove and replace damaged, defective, or undercharged fire extinguishers.

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

3.2 INSTALLATION

A. General: Install fire extinguishers and mounting brackets in locations indicated and in compliance with requirements of authorities having jurisdiction.

B. Mounting Brackets: Fasten mounting brackets to surfaces, square and plumb, at locations indicated.

1. Mounting Height: Top of fire extinguisher to be at 42 inches above finished floor.

END OF SECTION 10 44 16

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SECTION 11 66 23 - GYMNASIUM EQUIPMENT

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Basketball equipment.
2. Volleyball equipment.
3. Safety pads.

B. Related Requirements:

1. Section 033000 "Cast-in-Place Concrete" for installation of floor-insert sleeves to be cast in concrete slabs and footings.
2. Section 096566 "Resilient Athletic Flooring" for game lines and markers.

1.2 DEFINITIONS

A. BWF: Badminton World Federation.

B. FIBA: Federation Internationale de Basketball (The International Basketball Federation).

C. FIVB: Federation Internationale de Volleyball (The International Volleyball Federation).

D. NBA: National Basketball Association.

E. NCAA: The National Collegiate Athletic Association.

F. NFHS: National Federation of State High School Associations.

G. WNBA: Women's National Basketball Association.

1.3 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of specified product.

1. Include assembly, disassembly, and storage instructions for removable equipment.
2. Motors: Show nameplate data, ratings, characteristics, and mounting arrangements.

B. Shop Drawings: For gymnasium equipment.

1. Include plans, elevations, sections, and attachment details.
2. Include details of field assembly for removable equipment, connections, installation, mountings, floor inserts, and operational clearances.
3. Include transport and storage accessories for removable equipment.
4. Include diagrams for power, signal, and control wiring.

C. Samples for Initial Selection: For each type of gymnasium equipment.

1.5 INFORMATIONAL SUBMITTALS

A. Coordination Drawings: Court layout plans, reflected ceiling plans, and other details, drawn to scale, and coordinated with ceiling-suspended gymnasium equipment, floor inserts, game lines, and markers applied to finished flooring, and coordinated with each other, using input from installers of the items involved:

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1. Structural members to which overhead-supported gymnasium equipment will be attached.
2. Suspended ceiling components, if any.
3. Items supported from building structure above the courts, including the following:

    a. Luminaires.
    b. Air outlets and inlets.
    c. Speakers.
    d. Sprinklers.
    e. Smoke detectors.
    f. Acoustical treatments or panels.
    g. Access panels.

B. Setting Drawings: For embedded items and cutouts required in other work.

C. Product Certificates: For each type of gymnasium equipment.

D. Qualification Statements: For Installer.

E. Field Quality Control Reports: For specified tests and inspections.

F. Sample Warranties: For specified special warranties.

1.6 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For gymnasium equipment.

1.7 QUALITY ASSURANCE

A. Installer Qualifications: An entity that employs installers and supervisors who are trained and approved by manufacturer.

1.8 FIELD CONDITIONS

A. Field Measurements: Verify position and elevation of floor inserts and layout for gymnasium equipment.

1.9 WARRANTY

A. Special Warranty: Manufacturer agrees to repair or replace components of gymnasium equipment that fail in materials or workmanship within specified warranty period.

1. Failures include, but are not limited to, the following:

    a. Basketball backboard failures, including glass breakage.
    b. Faulty operation of basketball backstops.

2. Warranty Period: 25 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 SOURCE LIMITATIONS

A. Source Limitations: Obtain gymnasium equipment from single source from single manufacturer.

2.2 BASKETBALL EQUIPMENT

A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1. AALCO Manufacturing
2. ADP Lemco
3. Arizona Courtlines, Inc.

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4. Basketball Products International
5. Bison, Inc.
6. Douglas Industries, Inc.
7. Draper, Inc.
8. IPI by Bison
9. Jaypro Sports, LLC
10. L.A. Steelcraft, a brand of Americana Outdoor
11. P. W. Athletic Mfg. Co.
12. Performance Sports Systems
13. Porter Athletic Equipment Company
14. SNA Sports Group
15. Spalding

B. Seismic Performance: Basketball backstops and anchors shall withstand the effects of earthquake motions determined according to ASCE/SEI 7.

C. Protruding fasteners or exposed bolt heads on front face of backboards are not permitted.

D. Connections: Manufacturer's standard connections or connections recommended in writing by manufacturer and complying with Section 055000 "Metal Fabrications" of size and type required to transfer loads to building structure.

E. Overhead-Supported Backstops: Complete assembly extending from overhead, including support framing to building structure, wall bracing, cables, support chains, pulleys, fittings, hardware, pipe anchors, equipment pads, and fasteners.

1. Stationary Type: Manufacturer's standard assembly.
2. Folding Type: Manufacturer's standard assembly for forward-folding, front-braced backstop, with hardware and fittings to permit folding.
3. Framing: Steel pipe, tubing, and shapes designed to minimize vibration during play.

   a. Center-Mast Frame: Welded and bolted or clamped with side sway bracing.
   b. Dual-Mast Frame: Welded and bolted or clamped with cross bracing.
   c. Finish: Manufacturer's standard polyester powder-coat finish.

4. Goal Height Adjuster: Adjustable from **8 to 10 feet** to top of ring with gear-drive mechanism, locking in any position within adjustment range, with visible height scale attached to side of framing.

   a. Operation:

      1) Manual operation with detachable crank handle.

F. Wall-Mounted Backstops: Complete assembly extending from wall, including support framing to building structure, bracing, cables, support chains, pulleys, fittings, hardware, pipe anchors, equipment pads, and fasteners.

1. Stationary Type: Manufacturer's standard assembly for stationary backstop.
2. Folding Type: Manufacturer's standard assembly for upward or side -folding backstop.
3. Framing: Steel pipe, tubing, and shapes designed to minimize vibration during play.

   a. Finish: Manufacturer's standard polyester powder-coat finish.

4. Extension: As indicated on Drawings.
5. Goal Height Adjuster: Adjustable from **8 to 10 feet** to top of ring with gear-drive mechanism, locking in any position within adjustment range, with visible height scale attached to side of framing.

   a. Operation:

      1) Manual: Manual operation with detachable crank handle.

G. Winch: Hoist consisting of heavy-duty, fully enclosed worm-gear; brake; cable drum; cable; and fittings, for mounting on wall with equipment-mounting board; designed to move and hold backboard in any raised or lowered position.

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1. Operation: Manual winch with detachable hand crank.
2. Portable Winch Operator: One portable electric motor-drive device(s), including adaptor to fit crank mechanism.

H. Backstop Electric Operator: Provide operating machine of size and capacity recommended in writing by manufacturer for equipment specified, with electric motor and factory-prewired motor controls, starter, gear-reduction unit, and remote controls. Coordinate wiring requirements and electrical characteristics with building electrical system.

1. Electrical Components, Devices, and Accessories: Listed and labeled according to NFPA 70, by a qualified testing agency, and marked for intended location and application.
2. Operator Type: Cable drum with grooved drum and cable tension device to automatically take up cable slack and retain cable in grooves.
3. Operator Mounting: On wall with equipment-mounting board.
4. Motor Electrical Characteristics:

   a. Horsepower: 1 hp.
   b. Voltage: 115 V ac, single phase, 60 hertz.

5. Remote-Control Station(s): NEMA ICS 6, Type 1 enclosure for surface mounting and momentary-contact, three-position, switch-operated control with up, down, and off functions.

   a. Group Key Switch Control Stations: One switch per each backstop.
   b. Keys: Provide one key per station.
   c. Switches, Ganged: Single faceplate with multiple switch cutouts as indicated on Drawings.
   d. Control Station Enclosure: Provide prime-painted metal enclosure with key access, with two sets of keys per enclosure.
   e. Radio Controls: One per backstop winch and two portable multiple-channel transmitters for operating two backstops individually with up and down functions.

6. Limit Switches: Adjustable switches at each backstop, interlocked with motor controls and set to automatically stop backstop at fully retracted and fully lowered positions.

I. Basketball Backboards:

1. Shape and Size:

   a. Rectangular, 72 by 48 inches width by height .

2. Backboard Material: Provide with predrilled holes or preset inserts for mounting goals, and as follows:

   a. Fiberglass: Minimum **1-1/2-inch-** thick, composite backboard consisting of minimum two **3/16-inch-** thick, molded-fiberglass panels laminated together over faces and edges encapsulating a **3/4-inch** honeycomb core, reinforced at goal and backboard mountings, or a wood panel product core; with threaded inserts or embedded anchors for mounting backboard corners to support framing at standard mounting centers.
   b. Glass: Minimum **1/2-inch-** thick, transparent tempered glass according to ASTM C1048Kind FT (fully tempered) and with impact-testing requirements in 16 CFR 1201 Category II or ANSI Z97.1 Class A for safety glazing.

      1) Frame: Provide glass with impact-absorbing resilient rubber or PVC gasket around perimeter in a fully welded, brushed-natural-finish, extruded-aluminum frame, with steel subframe, reinforcement, bracing, and mounting slots for mounting backboard frame to backstop.
      2) Standard Mount: Provide steel corner reinforcement with mounting slots for mounting backboard frame to backstop at standard mounting centers. Provide center-strut frame reinforcement.
      3) Direct Mount: Designed for mounting backboard frame to center mast of backstop, to maximize stress relief on backboard frame and glass.
      4) Rim-Restraining Device: According to NCAA and NFHS rules and designed to ensure that basket remains attached if glass backboard breaks.

   c. Steel: Single-piece, steel face sheet, minimum 0.1046-inch nominal thickness, with **1-**

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1/2-inch- deep, roll-edged perimeter flange and with steel-reinforced, welded frame welded to back side of backboard; with mounting slots for mounting backboard frame to backstop at standard mounting centers.

d. Hardwood or Particleboard: Minimum **1-1/2-inch-** thick backboard consisting of minimum **1/32-inch-** thick, phenolic-resin-impregnated cellulose and paper laminate over front and back sides of **1-1/2-inch** hardwood or particleboard core; with painted edges and corners and with threaded inserts or slotted brackets for mounting backboard corners to backstop at standard mounting centers.

3. Target Area and Border Markings for Clear Tempered Glass: Permanently etched in white color, marked in manufacturer's standard pattern and stripe width.
4. Finish: Manufacturer's standard factory-applied, white background.

J. Goal-Mounting Assembly: Compatible with goal, backboard, and backstop; with manufacturer's standard hole pattern for goal attachment.

1. Glass Backboard Goal-Mounting Assembly: Goal support framing and reinforcement designed to transmit load from goal to backstop and to minimize stresses on glass backboard.
2. Direct Mount: Designed for mounting goal directly and independently to center mast of backstop, so that no force is transmitted by ring directly to backboard, and rigidity and stability of goal are maximized.

K. Basketball Goals: Basket ring complete with flanges, braces, attachment plate, and evenly spaced loops welded around underside of ring.

1. Single-Rim Basket Ring Competition Goal: Materials, dimensions, and fabrication per manufacturer's standard design.
2. Type:

a. Fixed: Nonmovable.
b. Movable: Pressure-release design with manufacturer's standard breakaway mechanism and rebound characteristics identical to those of fixed, nonmovable ring.

3. Pressure-Release Characteristics: Positive-lock movable breakaway design, with manufacturer's standard mechanism, including preset pressure release, set to release between 181- and 231-lb load, and automatic reset. Provide movable ring with rebound characteristics identical to those of fixed, nonmovable ring.
4. Field Adjustment: Provide ring that is field adjustable for rebound elasticity without being removed from the backboard.
5. Mount: Front.
6. Net Attachment: No-tie loops for attaching net to ring without tying.
7. Finish: Manufacturer's standard finish.

L. Basketball Nets: 12-loop-mesh net, between **15 and 18 inches** long, sized to fit ring diameter, and as follows:

1. Cord: Made from white nylon.
2. Competition Cord: Antiwhip, made from white nylon cord, minimum 120-gm thread and maximum 144-gm thread.

M. Backboard Safety Pads: Designed for backboard thickness and extending continuously along bottom and up sides of backboard and over backstop as indicated on Drawings.

1. Attachment: Manufacturer's standard.
2. Color: As selected by Architect from manufacturer's full range.

2.3 VOLLEYBALL EQUIPMENT

A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1. AALCO Manufacturing
2. ADP Lemco
3. Arizona Courtlines, Inc.

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4. Bison, Inc.
5. Douglas Industries, Inc.
6. Draper, Inc.
7. IPI by Bison
8. Jaypro Sports, LLC
9. L.A. Steelcraft, a brand of Americana Outdoor
10. P. W. Athletic Mfg. Co.
11. Performance Sports Systems
12. Porter Athletic Equipment Company
13. SNA Sports Group
14. Spalding
15. Sports Imports, Inc.

B. Standard Rules: Provide equipment according to the requirements of NFHS's "Volleyball Rules Book."

C. Floor Insert: Chrome-finished steel floor plate and steel pipe sleeve, concealed by floor plate, with capped bottom end, sized with ID to fit post standards, minimum length required, to securely anchor pipe sleeve below finished floor in concrete footing; with anchors designed for securing floor insert to floor substrate indicated; quantity as indicated on Drawings.

1. Flush Floor Plate: Manufacturer's standard hinged access cover, designed to be flush with adjacent flooring. Provide two tool(s) for unlocking access covers.
2. Recessed Floor Plate: Manufacturer's standard hinged access cover, recessed to accept finish flooring matching, and designed to be level with adjacent flooring. Provide two tool(s) for unlocking access covers.

D. Post Standards: Removable, adjustable-height, telescoping, paired volleyball post standards , as indicated on Drawings, designed for easy removal from permanently placed floor inserts.

1. Materials: Manufacturer's standard metal pipe or tubing, with nonmarking plastic or rubber end cap or floor bumper to protect permanent flooring.
2. Nominal Pipe or Tubing Diameter: 3-1/2-inch OD at base.
3. Finish: Manufacturer's standard factory-applied, polyester powder-coat finish.
4. Net Height Adjuster: Manufacturer's standard mechanism for height adjustment, complete with fittings; designed for positioning net at heights indicated.

   a. Net Heights: Between tennis net height and boys'/men's volleyball net height, 42 and 95-5/8 inches or more.

5. Height Markers: Clearly marked at regulation play heights for elementary school tennis.

E. Net: **32 feet** long; one per pair of paired post standards; and as follows:

1. Width and Polyester Mesh: **36 inches** with **4-1/2-inch-** square mesh made of black polyester string.

   a. Hem Band Edges: White, **2-inch-** wide top binding; black, 3/4-inch- wide bottom and side bindings; tie offs at top and bottom of each side end of net; and **1/4-inch-** diameter rope, at least **42 feet** long, threaded through top hem of binding.

2. Width and Nylon Mesh: Competition volleyball net, 36 inches with **4-inch-** square knotless mesh made of black nylon string.

   a. Hem Band Edges: White, minimum **2-inch-** wide top, bottom, and side bindings; tie offs at top, bottom, and midpoint of each side end of net; end sleeves for dowels; and lines with linkage fittings threaded through top and bottom hems of binding. Provide lengths of lines and linkage fittings as required to properly connect to and set up net for post-standard spacing indicated on Drawings.

      1) Top Line: Minimum 1/4-inch- diameter rope.
      2) Bottom Line: Minimum 1/4-inch- diameter rope.

3. Dowels: Minimum **1/2-inch-** diameter fiberglass or **1-inch-** diameter wood. Provide two dowels per net threaded through each side hem sleeve for straightening net side edges.
4. Net Antennas: **3/8-inch-** diameter, high-tensile-strength, extruded-fiberglass or plastic rods, **72**

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inches long, extending above top hem band of net, with alternating white and red bands according to referenced standard rules. Provide two antennas per net.

a. Clamps: Designed to secure antenna to top and bottom of net.

5. Boundary Tape Markers: **2-inch-** wide white strip with sleeve for securing net antenna, secured to net top and bottom with hook-and-loop attachment. Provide two tape markers per net for marking court boundaries.

F. Net-Tensioning System: Designed to adjust and hold tension of net. Fully enclosed, nonslip, manufacturer's standard -type winch with cable length and fittings for connecting to net lines, positive-release mechanism, and manufacturer's standard handle. Mount net tensioner on post standard at side away from court. Provide end post with post top pulley. Provide opposing post with welded-steel loops, hooks, pins, or other devices for net attachment and post top grooved line guide.

G. Bottom Net Lock Tightener: Manufacturer's standard quick-release-type tension strap; a spring-loaded, self-locking tensioner; a turnbuckle; a pulley; or other device and linkage fittings designed to quickly and easily tighten bottom line or net.

H. Safety Pads: Consisting of minimum 1-1/4-inch- thick, multiple-impact-resistant manufacturer's standard foam filler covered by puncture- and tear-resistant fabric cover , manufacturer's standard; with fire-test-response characteristics indicated . Provide pads with hook-and-loop closure or attachments for the following components:

1. Post Standards: Wraparound style pads, designed to totally enclose each standard to a minimum height of 72 inches; one per post.
2. Net Lines: Four per net.
3. Judges' Stands: Pads designed to totally enclose front and sides.
4. Fabric Cover Flame-Resistance Ratings: Complies with NFPA 701.
5. Fabric Color: As selected by Architect from full range of industry standard colors and color densities.
6. Graphics: Custom graphics as indicated on Drawings.

2.4 SAFETY PADS

A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1. AALCO Manufacturing
2. ADP Lemco
3. American Athletic, Inc
4. Bison, Inc.
5. Douglas Industries, Inc.
6. Draper, Inc.
7. IPI by Bison
8. Jaypro Sports, LLC
9. Performance Sports Systems
10. Porter Athletic Equipment Company
11. SNA Sports Group
12. Spalding
13. Sports Imports, Inc.

B. Surface-Burning Characteristics: Comply with ASTM E84; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.

1. Flame-Spread Index: 25 or less.
2. Smoke-Developed Index: 450 or less.

C. Pad Coverings: Provide safety pad fabric covering that is fabricated from puncture- and tear-resistant, PVC-coated polyester or nylon-reinforced PVC fabric, minimum **14-oz./sq. yd.** and treated with fungicide for mildew resistance; with surface-burning characteristics indicated .

D. Wall Safety Pads: Padded wall wainscot panels designed to be attached in a continuous row; each panel section consisting of fill laminated to backer board, with visible surfaces fully covered by

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seamless fabric covering, free of sag and wrinkles and firmly attached to back of backer board.

1. Backer Board: Minimum **3/8-inch-** thick plywood, mat formed, or composite panel.
2. Fill: Multiple-impact-resistant foam, minimum 2-inch- thick polyurethane, 3.5-lb/cu. ft. density.
3. Size: Each panel section of manufacturer's standard dimensions.
4. Number of Modular Panel Sections: As indicated on Drawings.
5. Installation Method: Manufacturer's standard.
6. Fabric Covering Color(s): As selected by Architect from manufacturer's full range for one color(s).

E. Cutout Trim: Manufacturer's standard flanged cutout trim kits for fitting pads around switches, receptacles, and other obstructions.

1. Color: Black.

2.5 MATERIALS

A. Support Cable: Manufacturer's standard galvanized-stranded-steel wire rope with a breaking strength of 7000 lb. Provide fittings according to the wire rope manufacturer's written instructions for size, number, and installation method.

B. Support Chain and Fittings: For chains used for overhead lifting, provide Grade 80 heat-treated alloy-steel chains, according to ASTM A391/A391M, with commercial-quality, hot-dip galvanized or zinc-plated steel connectors and hangars.

C. General-Purpose Chain: For chains not used for overhead lifting, provide carbon steel chain, according to ASTM A413/A413M (Grade 30 proof coil chain or higher grade recommended by gymnasium equipment manufacturer). Provide coating type, chain size, number, and installation method according to manufacturer's written instructions.

D. Castings and Hangers: Malleable iron, according to ASTM A47/A47M; grade as required for structural loading.

E. Softwood Plywood: DOC PS 1, exterior.

F. Particleboard: ANSI A208.1.

G. Equipment-Mounting Board: Wood, transparent or neutral-color-painted finish; size and quantity as required to mount gymnasium equipment according to manufacturer's written instructions.

H. Anchors, Fasteners, Fittings, and Hardware: Gymnasium equipment manufacturer's standard corrosion-resistant or noncorrodible units; concealed ; tamperproof, vandal- and theft-resistant design.

I. Grout: Nonshrink, nonmetallic, premixed, factory-packaged, nonstaining, noncorrosive, nongaseous grout, according to ASTM C1107/C1107M, with minimum strength recommended in writing by gymnasium-equipment manufacturer.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for court layout, alignment of mounting substrates, installation tolerances, operational clearances, accurate locations of connections to building electrical system, and other conditions affecting performance of the Work.

1. Verify critical dimensions.
2. Examine supporting structure, subgrades, subfloors, and footings below finished floor.
3. Examine wall assemblies, where reinforced to receive anchors and fasteners, to verify that locations of concealed reinforcements are clearly marked. Locate reinforcements and mark locations.

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

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3.2 INSTALLATION OF GYMNASIUM EQUIPMENT, GENERAL

A. Comply with manufacturer's written installation instructions and competition rules for each type of gymnasium equipment.

B. Install gymnasium equipment after other finishing operations, including painting, have been completed unless otherwise indicated.

C. Permanently Placed Gymnasium Equipment and Components: Install rigid, level, plumb, square, and true; anchored securely to supporting structure; positioned at locations and elevations indicated; in proper relationship to adjacent construction; and aligned with court layout.

1. Floor-Insert Locations: Coordinate locations with application of game lines and markers , and core drill floor for inserts after game lines are applied.
2. Floor-Insert Elevation: Coordinate installed heights of floor inserts with installation and field finishing of finish flooring and floor-plate type.
3. Operating Gymnasium Equipment: Verify clearances for movable components of gymnasium equipment throughout entire range of operation and for access to operating components.

D. Floor-Insert Setting: Clean oversized, recessed voids in concrete substrate of debris. Position each sleeve, and fill void around sleeve with grout, mixed and placed according to grout manufacturer's written instructions. Protect portion of sleeve above subfloor and footing from splatter. Verify that sleeves are set plumb, aligned, and at correct height and spacing; hold in position during placement and finishing operations until grout is sufficiently cured. Set insert so top surface of completed unit is flush with finished flooring surface.

E. Anchoring to In-Place Construction: Use anchors and fasteners where necessary to secure built-in and permanently placed gymnasium equipment to structural support and to properly transfer load to in-place construction.

F. Connections: Connect electric operators to building electrical system.

G. Removable Gymnasium-Equipment Components: Assemble in place to verify that equipment and components are complete and in proper working order. Disassemble removable gymnasium equipment after assembled configuration is approved by Architect, and store units in location indicated on Drawings.

3.3 INSTALLATION OF SAFETY PADS

A. Mount with bottom edge at 4 inches above finished floor.

B. Cutout Trim: Limit cuts in face of padding so that cuts are securely and fully concealed behind trim-kit flange.

3.4 FIELD QUALITY CONTROL

A. Testing Agency: Owner will engage a qualified testing agency to perform tests and inspections.

B. Tests and Inspections: Perform the following tests and inspections :

1. Perform visual inspections and operational tests as recommended by referenced standard rules of each sport and the equipment manufacturer.
2. Test rebound elasticity of basketball goals.
3. Test basketball goal pressure-release characteristics and adjustability.
4. Gymnasium equipment will be considered defective if it does not pass tests and inspections.

C. Prepare test and inspection reports.

3.5 ADJUSTING

A. Adjust movable components of gymnasium equipment to operate safely, smoothly, easily, and quietly; free from binding, warp, distortion, nonalignment, misplacement, disruption, or malfunction, throughout entire operational range; and lubricate as recommended in writing by manufacturer.

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3.6 DEMONSTRATION

A. Train Owner's maintenance personnel to adjust, operate, and maintain gymnasium equipment.

END OF SECTION 11 66 23

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SECTION 11 66 53 - GYMNASIUM DIVIDERS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Roll-up divider systems.
2. Electric operators.
3. Divider curtains.
4. Divider system accessories.

1.2 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Motors: Show nameplate data, ratings, characteristics, and mounting arrangements.

B. Shop Drawings: For gymnasium dividers.

1. Include plans showing alignment of curtains in relation to sport-court layout and overhead structural supports.
2. Include elevations, sections, details, and attachments to other work.
3. Include system clearances, stacking requirements, and limits for fitting into adjacent construction.
4. Include point loads and locations for attachment of gymnasium dividers to structure.
5. Include diagrams for power, signal, and control wiring.

C. Samples: For each exposed product and for each item and color specified.

D. Samples for Initial Selection: For each type of gymnasium divider curtain fabric.

E. Samples for Verification: For divider curtain fabrics, not less than **12 inches** square of mesh and.

1.4 INFORMATIONAL SUBMITTALS

A. Coordination Drawings: Reflected ceiling plans with divider-curtain layouts, drawn to scale, on which the following items are shown and coordinated with each other, based on input from installers of the items involved:

1. Structural members to which divider-curtain systems will be attached.
2. Suspended ceiling components, if any.
3. Items supported from building structure, including the following:

a. Lighting fixtures.
b. Air outlets and inlets.
c. Speakers.
d. Sprinklers.
e. Smoke detectors.
f. Acoustical treatments or panels.
g. Access panels.
h. <**Insert item**>.

B. Qualification Data: For Installer.

C. Product Certificates: For each type of gymnasium divider.

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D. Sample Warranty: For special warranty.

1.5 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For gymnasium dividers to include in operation and maintenance manuals.

1.6 QUALITY ASSURANCE

A. Installer Qualifications: Fabricator of products.

1.7 WARRANTY

A. Special Warranty: Manufacturer agrees to repair or replace components of gymnasium dividers that fail in materials or workmanship within specified warranty period.

1. Failures include, but are not limited to, the following:

   a. Faulty operation of gymnasium dividers.
   b. Tearing or deterioration of fabric, seams, or other materials beyond normal use.

2. Warranty Period: Five years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 ROLL-UP DIVIDER SYSTEMS

A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1. ADP Lemco
2. Arizona Courtlines, Inc.
3. Draper, Inc.
4. IPI by Bison
5. Jaypro Sports, LLC
6. Performance Sports Systems
7. Porter Athletic Equipment Company

B. Source Limitations: Obtain from single source from single manufacturer.

C. Divider-Curtain System: Electrically operated with roll-up drive pipe, and as follows:

1. Top Hem: Double-thickness mesh or solid vinyl for continuous pipe batten.
2. Outer Edge Hems: Double turned and welded.
3. Belts: Manufacturer's standard width polyester or polyurethane webbing or fabric belts, attached to top batten, passing under bottom batten and terminating at drive pipe, with friction surface on one side of belt or other means of drawing up curtain by rolling at bottom batten.
4. Support Chain and Fittings: Hardened alloy-steel chain rated for lifting loads indicated, with commercial-quality, corrosion-resistant steel connectors and hangers.
5. Curtain Battens and Drive Pipe: Fabricate from steel pipe or tubing with a minimum number of joints, as necessary for required lengths. Provide galvanized battens, or shop prime and shop finish with black paint.

   a. Drive Pipe: **2-3/8-inch-** nominal diameter steel pipe.
   b. Top Batten: **1-1/2-inch-** nominal diameter steel pipe.
   c. Bottom Batten: **3-1/2-inch-** nominal diameter steel pipe.

2.2 ELECTRIC OPERATORS

A. Provide factory-assembled electric operation system of size and capacity recommended in writing and provided by gymnasium divider manufacturer for gymnasium dividers specified, with electric motors and factory-prewired motor controls, control devices, and accessories required for proper operation.

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1. Include wiring from control stations to motors and between synchronizer and dual motors for long curtains. Coordinate operator wiring requirements and electrical characteristics with building electrical system.

B. Electrical Components, Devices, and Accessories: Listed and labeled according to NFPA 70, by a qualified testing agency, and marked for intended location and application.

C. Limit Switches: Adjustable switches at each divider curtain, interlocked with motor controls and set to automatically stop divider curtain at fully extended and fully retracted positions.

D. Control System:

1. Key-Switch Operation: NEMA ICS 6, Type 1 enclosure, momentary-contact, three-position switch-operated control with up, down, and off functions.

a. Group Key-Switch Control: One switch per each curtain.
b. Switches, Ganged: Single faceplate with multiple switch cutouts as indicated on Drawings.
c. Keys: Provide two key(s) per station.

2. Radio control system.
3. Keypad control system.
4. Wireless control system.
5. Touch-screen programmable operating system.

2.3 DIVIDER CURTAINS

A. Curtain, Mesh: Woven mesh of polyester yarn coated with vinyl, weighing not less than 9 oz./sq. yd..

1. Mesh Color: As selected by Architect from full range of industry colors and color densities.

B. Upper Curtain, Mesh: Woven mesh of polyester yarn coated with vinyl, weighing not less than 9 oz./sq. yd..

1. Mesh Color: As selected by Architect from full range of industry colors and color densities.

C. Lower Curtain, Solid: Woven polyester fabric coated with vinyl, 18 oz./sq. yd., 8-foot height above floor.

1. Fabric Color(s): One color(s), as selected by Architect from full range of industry colors and color densities.

D. Hems: Folded and electronically welded.

E. Seams: Electronically welded.

F. Overall Curtain Height: Floor to ceiling, within installation clearances required.

G. Bottom of Curtain: Approximately **2 inches** above finished floor.

H. Divider-Curtain Flame-Resistance Rating: Passes NFPA 701 Test 2.

2.4 DIVIDER SYSTEM ACCESSORIES

A. Safety Lock: Locks drive system when speed exceeds manufacturer's recommended speed.

B. Audible Motion Alarm: Provide alarm with intermittent warning tone when curtain is raised or lowered.

2.5 SUPPORT MATERIALS AND FASTENERS

A. Support Chain and Fittings: For chains used for overhead lifting, provide Grade 80, heat-treated alloy-steel chains, according to ASTM A391/A391M, with commercial-quality, hot-dip galvanized steel connectors and hangers.

B. General-Purpose Chain: For chains not used for overhead lifting, provide carbon steel chain,

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according to ASTM A413/A413M, Grade 30 proof coil chain or higher grade recommended by gymnasium divider manufacturer. Provide coating type, chain size, number, and installation method according to manufacturer's written instructions.

C. Anchors, Fasteners, Fittings, and Hardware: Manufacturer's standard corrosion-resistant or noncorrodible units; concealed ; tamperproof, vandal-resistant design.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for alignment of mounting substrates, installation tolerances, operational clearances, locations of connections to building electrical system, and other conditions affecting performance of the Work.

1. Verify critical dimensions.
2. Examine supporting structure.
3. Examine wall assemblies, where reinforced to receive anchors and fasteners, to verify that locations of concealed reinforcements are clearly marked. Locate reinforcements and mark locations.

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

3.2 INSTALLATION, GENERAL

A. Comply with manufacturer's written installation instructions.

B. Install gymnasium dividers after other finishing operations, including painting, have been completed unless otherwise indicated.

C. Install gymnasium dividers level, plumb, square, and true; anchored securely to supporting structure; positioned at locations and elevations indicated; in proper relation to adjacent construction; and aligned with sport-court layout.

1. Verify clearances for movable components of gymnasium dividers throughout entire range of operation and for access to operating components.

D. Electric Operators Installation: Connect electric operators to building electrical system.

3.3 ADJUSTING

A. Adjust movable components of gymnasium dividers to operate safely, smoothly, easily, and quietly, free from binding, warp, distortion, uneven tension, nonalignment, misplacement, disruption, or malfunction, throughout entire operational range; and lubricate as recommended in writing by manufacturer.

B. Limit Switch Adjustment: Set and adjust upper and lower limit controls.

3.4 DEMONSTRATION

A. Train Owner's maintenance personnel to adjust, operate, and maintain gymnasium dividers.

END OF SECTION 11 66 53

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SECTION 12 36 23.13 - PLASTIC-LAMINATE-CLAD COUNTERTOPS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Plastic-laminate-clad countertops.
2. Accessories.

B. Related Requirements:

1. Section 055000 "Metal Fabrications" for cantilever supports.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of specified product.

1. Include data for fire-retardant treatment from chemical-treatment manufacturer and certification by treating plant that treated materials comply with requirements.

B. Shop Drawings:

1. Plans, sections, details, edge and backsplash profiles, and attachments to other work.
2. Locations and details of joints.
3. Locations and sizes of cutouts and holes for items installed in countertop.

C. Samples for Initial Selection: Plastic laminates in each type, color, pattern, and surface finish required in manufacturer's standard size.

D. Samples for Verification:

1. Plastic Laminates: For each type, color, pattern, and surface finish required, 8 by 10 inches in size.

1.3 INFORMATIONAL SUBMITTALS

A. Coordination Drawings: Indicate locations and sizes of cutouts and holes for items installed in countertop and backsplashes.

B. Product Certificates: For the following:

1. Composite wood products.
2. High-pressure decorative laminate.
3. Chemical-resistant, high-pressure decorative laminate.

C. Qualification Statements: For Fabricator.

1.4 QUALITY ASSURANCE

A. Fabricator Qualifications: Shop that employs skilled workers who custom fabricate products similar to those required for this Project and whose products have a record of successful in-service performance.

B. Installer Qualifications: Fabricator of products.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Deliver countertops only after casework and supports on which they will be installed have been completed in installation areas.

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B. Store countertops in areas where environmental conditions comply with requirements specified in "Field Conditions" Article.

C. Keep surfaces of countertops covered with protective covering during handling and installation.

1.6 FIELD CONDITIONS

A. Environmental Limitations without Humidity Control: Do not deliver or install countertops until building is enclosed, wet-work is complete, and HVAC system is operating and maintaining temperature and relative humidity at levels planned for building occupants during the remainder of the construction period.

B. Environmental Limitations with Humidity Control: Do not deliver or install countertops until building is enclosed, wet-work is complete, and HVAC system is operating and maintaining temperature between **60 and 90 deg F** and relative humidity between 25 and 55 percent during the remainder of the construction period.

C. Field Measurements: Where countertops are indicated to fit to other construction, verify dimensions of other construction by field measurements before fabrication and indicate measurements on Shop Drawings. Coordinate fabrication schedule with construction progress to avoid delaying the Work.

D. Established Dimensions: Where countertops are indicated to fit to other construction, establish dimensions for areas where countertops are to fit. Provide allowance for trimming at site, and coordinate construction to ensure that actual dimensions correspond to established dimensions.

PART 2 - PRODUCTS

2.1 PLASTIC-LAMINATE-CLAD COUNTERTOPS

A. Quality Standard: Unless otherwise indicated, comply with ANSI/AWI 1236 for grades of plastic-laminate-clad countertops indicated for construction, finishes, installation, and other requirements.

1. The Contract Documents contain requirements that are more stringent than that of the referenced quality standard. Comply with requirements of the Contract Documents in addition to those of referenced quality standard.

B. Plastic-Laminate-Clad Countertop Type :

1. Grade: Custom.
2. Plastic-Laminate Cladding: High-pressure decorative laminate.
3. Colors, Patterns, and Finishes: Provide materials and products that result in colors and textures of exposed laminate surfaces complying with the following requirements:

    a. As indicated by manufacturer's designations.

4. Edge Treatment: Same as laminate cladding on horizontal surfaces.
5. Core Material: Particleboard or MDF.
6. Core Material at Sinks: Particleboard made with exterior glue.
7. Core Thickness: 3/4 inch.

    a. Build up countertop thickness to **1-1/2 inches** at front, back, and ends with additional layers of core material laminated to top.
    b. Provide drip groove 1/8 by 1/8 inch set back 3/8 inch from front edge of countertop.

8. Backer Sheet: Provide plastic-laminate backer sheet, ISO 4586-3, grade to match exposed surface, on underside of countertop substrate.
9. Paper Backing: Provide paper backing on underside of countertop substrate.

2.2 PLASTIC LAMINATES

A. High-Pressure Decorative Laminate:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering

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products that may be incorporated into the Work include, but are not limited to, the following:

a. ABET Inc.
b. Formica Corporation
c. Laminart LLC
d. Nevamar Company, LLC
e. Pionite; a Panolam Industries International, Inc. brand
f. Wilsonart LLC

2. Standard: ISO 4586-3, Grade HGS.

B. Chemical-Resistant, High-Pressure Decorative Laminate:

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. Formica Corporation
b. Pionite; a Panolam Industries International, Inc. brand
c. Wilsonart LLC

2. Standard: ISO 4586-3, Grade HGP.
3. Physical Properties: Minimum acceptable chemical-resistance performance to result in no more than four (4) Level 3 conditions when tested with indicated reagents in accordance with SEFA 3.

2.3 WOOD MATERIALS

A. Wood Products: Provide materials that comply with requirements of referenced quality standard unless otherwise indicated.

B. Composite Panel Products: Provide materials that comply with requirements of referenced quality standard for each type of countertop and quality grade specified unless otherwise indicated.

1. Medium-Density Fiberboard (MDF): ANSI A208.2 , MR 30.

a. Grade: 130.

2. Particleboard: ANSI A208.1 , MR 30.

a. Grade: M-2.

3. Veneer-Core Hardwood Plywood: ANSI/HPVA HP-1.

2.4 FIRE-RETARDANT-TREATED MATERIALS

A. Fire-Retardant-Treated Materials, General: Where fire-retardant-treated materials are indicated, use materials that are acceptable to authorities having jurisdiction and with fire-test-response characteristics specified as determined by testing identical products in accordance with test method indicated by a qualified testing agency.

1. Use treated materials that comply with requirements of referenced quality standard. Do not use materials that are warped, discolored, or otherwise defective.
2. Use fire-retardant-treatment formulations that do not bleed through or otherwise adversely affect finishes. Do not use colorants to distinguish treated materials from untreated materials.
3. Identify fire-retardant-treated materials with appropriate classification marking of qualified testing agency in the form of removable paper label or imprint on surfaces that will be concealed from view after installation.

B. Fire-Retardant-Treated Plywood: Products with a flame-spread index of 25 or less when tested in accordance with ASTM E84, with no evidence of significant progressive combustion when the test is extended an additional 20 minutes, and with the flame front not extending more than **10.5 ft** beyond the centerline of the burners at any time during the test.

1. Kiln dry lumber and plywood after treatment to a maximum moisture content of 19 and 15 percent, respectively.

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C. Fire-Retardant Particleboard: Made from softwood particles and fire-retardant chemicals mixed at time of panel manufacture to achieve flame-spread index of 25 or less and smoke-developed index of 25 or less when tested in accordance with ASTM E84.

1. For panels **3/4 inch** thick and less, comply with ANSI A208.1 for Grade M except for the following minimum properties: modulus of rupture, **1600 psi**; modulus of elasticity, **300,000 psi**; internal bond, **80 psi**; and screw-holding capacity on face and edge, **250 and 225 lbf**, respectively.
2. For panels **13/16 to 1-1/4 inches** thick, comply with ANSI A208.1 for Grade M except for the following minimum properties: modulus of rupture, **1300 psi**; modulus of elasticity, **250,000 psi**; linear expansion, 0.50 percent; and screw-holding capacity on face and edge, **250 and 175 lbf**, respectively.

D. Fire-Retardant MDF: MDF panels complying with ANSI A208.2, made from softwood fibers, synthetic resins, and fire-retardant chemicals mixed together at time of panel manufacture to achieve flame-spread index of 25 or less and smoke-developed index of 200 or less in accordance with ASTM E84.

2.5 ACCESSORIES

A. Grommets:

1. Wire-Management Grommets: Circular grommets and matching caps with slot for wire passage.

a. Finish: Molded plastic.
b. Outside Diameter: 2 inches.
c. Color: Black.

B. Countertop Support Brackets :

1. Type: Hidden.
2. Material: Steel.
3. Color: Black powder coat.

2.6 MISCELLANEOUS MATERIALS

A. Adhesive for Bonding Plastic Laminate: Type I, waterproof type as selected by fabricator to comply with requirements.

1. Adhesive for Bonding Edges: Hot-melt adhesive or adhesive specified above for faces.

B. Installation Adhesive: Manufacturer's standard product that is recommended for application indicated.

2.7 FABRICATION

A. Sand fire-retardant-treated wood lightly to remove raised grain on exposed surfaces before fabrication.

B. Fabricate countertops to dimensions, profiles, and details indicated. Provide front and end overhang of **1 inch** over base cabinets. Ease edges to radius indicated for the following:

1. Solid-Wood (Lumber) Members: **1/16 inch** unless otherwise indicated.

C. Complete fabrication, including assembly, to maximum extent possible before shipment to Project site. Disassemble components only as necessary for shipment and installation. Where necessary for fitting at site, provide ample allowance for scribing, trimming, and fitting.

1. Notify Architect seven days in advance of dates and times countertop fabrication will be complete.
2. Trial fit assemblies at fabrication shop that cannot be shipped completely assembled. Install dowels, screws, bolted connectors, and other fastening devices that can be removed after trial fitting. Verify that various parts fit as intended, and check measurements of assemblies against field measurements before disassembling for shipment.

D. Shop cut openings to maximum extent possible to receive appliances, plumbing fixtures, electrical work, and similar items. Locate openings accurately, and use templates or roughing-in diagrams to

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produce accurately sized and shaped openings. Sand edges of cutouts to remove splinters and burrs.

1. Seal edges of cutouts by saturating with varnish.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates to receive countertops and conditions under which countertops will be installed, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of countertops.

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

3.2 PREPARATION

A. Before installation, condition countertops to average prevailing humidity conditions in installation areas.

B. Examine shop-fabricated work for completion and complete work as required, including removal of packing.

3.3 INSTALLATION OF PLASTIC-LAMINATE-CLAD COUNTERTOPS

A. Grade: Install countertops to comply with same grade as item to be installed.

B. Assemble countertops and complete fabrication at Project site to extent that it was not completed in the shop.

1. Provide cutouts for appliances, plumbing fixtures, electrical work, grommets, and similar items. Locate openings accurately, and use templates or roughing-in diagrams to produce accurately sized and shaped openings. Sand edges of cutouts to remove splinters and burrs.
2. Seal edges of cutouts by saturating with varnish.

C. Field Jointing: Where possible, make in the same manner as shop jointing, using dowels, splines, adhesives, and fasteners recommended by manufacturer. Prepare edges to be joined in shop so Project-site processing of top and edge surfaces is not required. Locate field joints where indicated on Shop Drawings.

1. Secure field joints in countertops with concealed clamping devices located within **6 inches** of front and back edges and at intervals not exceeding **24 inches**. Tighten in accordance with manufacturer's written instructions to exert a constant, heavy-clamping pressure at joints.

D. Fire-Retardant-Treated Materials: Handle, store, and install fire-retardant-treated materials to comply with chemical-treatment manufacturer's written instructions, including those for adhesives used to install woodwork.

E. Countertop Installation:

1. Scribe and cut countertops to fit adjoining work, refinish cut surfaces, and repair damaged finish at cuts.
2. Anchor securely by screwing through corner blocks of base cabinets or other supports into underside of countertop.
3. Anchor wall cleating necessary for proper setting for countertops not supported by casework.
4. Install countertops level and true in line. Use concealed shims as required to maintain not more than **1/8-inch-in-96-inch** variation from a straight, level plane.
5. Grommets: Install grommets in accordance with manufacturer's written instructions.
6. Secure backsplashes to walls with adhesive.
7. Seal joints between countertop and backsplash, if any, and joints where countertop and backsplash abut walls with mildew-resistant silicone sealant or another permanently elastic sealing compound recommended by countertop material manufacturer.

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3.4 ADJUSTING

A. Repair damaged and defective countertops, where possible, to eliminate functional and visual defects. Where impossible to repair, replace countertops. Adjust joinery for uniform appearance.

3.5 CLEANING

A. Clean countertops on exposed and semiexposed surfaces.

3.6 PROTECTION

A. Protection: Provide kraft paper or other suitable covering over countertop surfaces, taped to underside of countertop at a minimum of **48 inches** o.c. Remove protection at Substantial Completion.

END OF SECTION 12 36 23.13

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SECTION 14 24 00 - HYDRAULIC ELEVATORS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes: Hydraulic elevators.

B. Related Requirements:

1. Section 011000 "Summary" for purchase contract for elevators negotiated by Owner and assigned to Contractor.
2. Section 015000 "Temporary Facilities and Controls" for temporary use of elevators for construction purposes.
3. Section 033000 "Cast-in-Place Concrete" for setting sleeves, inserts, and anchoring devices in concrete.
4. Section 042000 "Unit Masonry" for setting sleeves, inserts, and anchoring devices in masonry and for grouting elevator entrance frames installed in masonry walls.
5. Section 051200 "Structural Steel Framing" for the following:

    a. Attachment plates, angle brackets, and other structural-steel preparations for fastening guide-rail brackets.
    b. Divider beams.
    c. Hoist beams.
    d. Structural-steel shapes for subsills that are part of steel frame.

6. Section 055000 "Metal Fabrications" for the following:

    a. Attachment plates and angle brackets for supporting guide-rail brackets.
    b. Divider beams.
    c. Hoist beams.
    d. Structural-steel shapes for subsills.
    e. Pit ladders.
    f. Cants made from steel sheet in hoistways.

7. Section 055213 "Pipe and Tube Railings" for railings between adjacent elevator pits.
8. Section 099123 "Interior Painting" for field painting of hoistway entrance doors and frames.
9. Section 284600 "Fire Detection and Alarm" for smoke detectors in elevator lobbies to initiate emergency recall operation and heat detectors in shafts and machine rooms to disconnect power from elevator equipment before sprinkler activation and for connection to elevator controllers.

1.2 DEFINITIONS

A. Definitions in ASME A17.1/CSA B44 apply to work of this Section.

B. Service Elevator: A passenger elevator that is also used to carry freight.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Include capacities, sizes, performances, operations, safety features, finishes, and similar information. Include product data for car enclosures; hoistway entrances; and operation, control, and signal systems.

B. Shop Drawings:

1. Include plans, elevations, sections, and large-scale details indicating service at each landing; machine room layout; coordination with building structure; relationships with other construction; and locations of equipment.

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2. Include large-scale layout of car-control station .
3. Indicate maximum dynamic and static loads imposed on building structure at points of support as well as maximum and average power demands.

C. Samples for Initial Selection: For finishes involving color selection.

D. Samples for Verification: For exposed car, hoistway door and frame, and signal equipment finishes, **3-inch-** square Samples of sheet materials and **4-inch** lengths of running trim members.

1.4 INFORMATIONAL SUBMITTALS

A. Qualification Data: For Installer.

B. Seismic Qualification Certificates: For elevator equipment, accessories, and components, from manufacturer.

1. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.
2. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.
3. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.

C. Manufacturer Certificates: Signed by elevator manufacturer, certifying that hoistway, pit, and machine room layout and dimensions, as indicated on Drawings, and electrical service , as indicated and specified, are adequate for elevator system being provided.

D. Sample Warranty: For special warranty.

1.5 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For elevators to include in emergency, operation, and maintenance manuals.

1. Submit manufacturer's/installer's standard operation and maintenance manual, in accordance with ASME A17.1/CSA B44 including diagnostic and repair information available to manufacturer's and Installer's maintenance personnel.

B. Inspection and Acceptance Certificates and Operating Permits: As required by authorities having jurisdiction for normal, unrestricted elevator use.

C. Continuing Maintenance Proposal:

1. Submit a continuing maintenance proposal from Installer to Owner, in the form of a standard one-year maintenance agreement, starting on date initial maintenance service is concluded. State services, obligations, conditions, and terms for agreement period and for future renewal options.
2. Submit a continuing maintenance proposal from Installer to Owner with terms, conditions, and obligations as set forth in, and in same form as, "Draft of Elevator Maintenance Agreement" at end of this Section, starting on date initial maintenance service is concluded.

1.6 QUALITY ASSURANCE

A. Installer Qualifications: Elevator manufacturer or an authorized representative who is trained and approved by manufacturer.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Deliver, store, and handle materials, components and equipment in manufacturer's protective packaging. Store materials, components, and equipment off of ground, under cover, and in a dry location.

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1.8 COORDINATION

A. Coordinate installation of sleeves, block outs, elevator equipment with integral anchors, and other items that are embedded in concrete or masonry for elevator equipment. Furnish templates, sleeves, elevator equipment with integral anchors, and installation instructions and deliver to Project site in time for installation.

B. Furnish well casing and coordinate delivery with related excavation work.

C. Coordinate locations and dimensions of other work specified in other Sections that relates to hydraulic elevators, including pit ladders; sumps and floor drains in pits; entrance subsills; electrical service; and electrical outlets, lights, and switches in hoistways, pits, and machine rooms.

1.9 WARRANTY

A. Manufacturer's Special Warranty: Manufacturer agrees to repair, restore, or replace elevator work that fails in materials or workmanship within specified warranty period.

1. Failures include, but are not limited to, operation or control system failure, including excessive malfunctions; performances below specified ratings; excessive wear; unusual deterioration or aging of materials or finishes; unsafe conditions; need for excessive maintenance; abnormal noise or vibration; and similar unusual, unexpected, and unsatisfactory conditions.
2. Warranty Period: 1 year(s) from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 HYDRAULIC ELEVATORS

A. Basis-of-Design Product: Subject to compliance with requirements, provide Thyssenkrupp Endura 2-Stage Series 3500# Machine Room-Less Hydraulic Elevator or comparable product by one of the following:

1. Otis Worldwide Corporation
2. Schindler Elevator Corp
3. ThyssenKrupp Elevator

B. Source Limitations: Obtain elevators from single manufacturer.

1. Major elevator components, including pump-and-tank units, plunger-cylinder assemblies, controllers, signal fixtures, door operators, car frames, cars, and entrances, are manufactured by single manufacturer.

2.2 PERFORMANCE REQUIREMENTS

A. Regulatory Requirements: Comply with ASME A17.1/CSA B44.

B. Accessibility Standard: Comply with applicable provisions in ICC A117.1.

C. Seismic Performance: Elevator system withstands the effects of earthquake motions determined according to ASCE/SEI 7 and complies with elevator seismic requirements in ASME A17.1/CSA B44.

1. The term "withstand" means "the system will remain in place without separation of any parts when subjected to the seismic forces specified ."
2. Project Seismic Design Category: D or as indicated in the general structural notes.
3. Elevator Component Importance Factor: 1.5.
4. Provide earthquake equipment required by ASME A17.1/CSA B44.
5. Provide seismic switch required by ASCE/SEI 7.

2.3 ELEVATORS

A. Elevator System, General: Manufacturer's standard elevator systems. Unless otherwise indicated, manufacturers' standard components are used, as included in standard elevator systems and as

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required for complete system.

B. Elevator Description:

1. Elevator Number(s): 1.
2. Type:

   a. Under-the-car single cylinder.

3. Rated Load: 3500 lb.
4. Rated Speed: 150 fpm or greater.
5. Operation System: Single automatic operation.
6. Auxiliary Operations:

   a. Battery-powered lowering.

7. Security Features: Card-reader operation.
8. Car Enclosures:

   a. Inside Height: Not less than 93 inches to underside of ceiling.
   b. Front Walls (Return Panels): Satin stainless steel, ASTM A480/A480M, No. 4 finish with integral car door frames.
   c. Car Fixtures: Satin stainless steel, ASTM A480/A480M, No. 4 finish.
   d. Side and Rear Wall Panels: Satin stainless steel, ASTM A480/A480M, No. 4 finish.
   e. Reveals: Satin stainless steel, ASTM A480/A480M, No. 4 finish.
   f. Door Faces (Interior): Satin stainless steel, ASTM A480/A480M, No. 4 finish.
   g. Door Sills: Aluminum.
   h. Ceiling: Satin stainless steel, ASTM A480/A480M, No. 4 finish.
   i. Handrails: 1/2 by 2 inches rectangular satin stainless steel, at sides and rear of car.

9. Hoistway Entrances:

   a. Width: 42 inches.
   b. Height: 84 inches.
   c. Type: Single-speed side sliding.
   d. Frames: Satin stainless steel, ASTM A480/A480M, No. 4 finish.
   e. Doors and Transoms: Satin stainless steel, ASTM A480/A480M, No. 4 finish.
   f. Sills: Aluminum.

10. Hall Fixtures: Satin stainless steel, ASTM A480/A480M, No. 4 finish.
11. Additional Requirements:

   a. Provide inspection certificate in each car, mounted under acrylic cover with frame made from satin stainless steel, ASTM A480/A480M, No. 4 finish.
   b. Provide hooks for protective pads in all cars and two complete set(s) of full-height protective pads.

2.4 SYSTEMS AND COMPONENTS

A. Pump Units: Positive-displacement type with a maximum of 10 percent variation between no load and full load and with minimum pulsations.

1. Pump is submersible type with submersible squirrel-cage induction motor, and suspended inside oil tank from vibration isolation mounts or is tank-top-mounted type with fan-cooled, squirrel-cage induction motor, and is mounted on oil tank with vibration isolation mounts and enclosed in prime-painted steel enclosure lined with 1-inch- thick, glass-fiber insulation board.
2. Motor has wye-delta or solid-state starting.
3. Motor has variable-voltage, variable-frequency control.

B. Hydraulic Silencers: System has hydraulic silencer containing pulsation-absorbing material in blowout-proof housing at pump unit.

C. Piping: Size, type, and weight of piping as recommended by elevator manufacturer, with flexible connectors to minimize sound and vibration transmissions from power unit.

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1. Cylinder units are connected with dielectric couplings.
2. Casing for Underground Piping: Schedule 40 PVC pipe complying with ASTM D1785, joined with PVC fittings complying with ASTM D2466 and solvent cement complying with ASTM D2564.

D. Hydraulic Fluid:

1. Hydraulic Fluid, Manufacturer's Standard: Elevator manufacturer's standard fluid with additives as needed to prevent oxidation of fluid, corrosion of cylinder and other components, and other adverse effects.
2. Hydraulic Fluid, Nontoxic and Biodegradable: Nontoxic, biodegradable fluid, made from vegetable oil with antioxidant, anticorrosive, antifoaming, and metal-passivating additives, that is approved by elevator manufacturer for use with elevator equipment.

E. Inserts: Furnish required concrete and masonry inserts and similar anchorage devices for installing guide rails, machinery, and other components of elevator work. Device installation is specified in another Section.

F. Protective Cylinder Casing: PVC or HDPE pipe casing complying with ASME A17.1/CSA B44, of sufficient size to provide not less than **1-inch** clearance from cylinder and extending above pit floor. Casing has means of monitoring effectiveness to comply with ASME A17.1/CSA B44.

G. Corrosion-Protective Filler: A nontoxic, petroleum-based gel formulated for filling the space between hydraulic cylinder and protective casing. Filler is electrically nonconductive, displaces or absorbs water, and gels or solidifies at temperatures below **60 deg F**.

H. Car Frame and Platform: Welded or bolted steel units.

2.5 OPERATION SYSTEMS

A. Provide manufacturer's standard microprocessor operation system as required to provide type of operation indicated.

B. Auxiliary Operations:

1. Single-Car Battery-Powered Lowering:

   a. If power fails and car is at a floor, it remains at that floor, opens its doors, and shuts down. If car is between floors, it is lowered to a preselected floor, opens its doors, and shuts down. If car is below the preselected floor, it is lowered to the next lower floor, opens its doors, and shuts down. System includes rechargeable battery and automatic recharging system.
   b. When power fails, car is lowered to the lowest floor, opens its doors, and shuts down. System includes rechargeable battery and automatic recharging system.

2. Loaded-Car Bypass: When car load exceeds 80 percent of rated capacity, car responds only to car calls, not to hall calls.
3. Off-Peak Operation: During periods of low traffic, half of the elevators in a group are taken out of service and switched to low-power mode.
4. Independent Service: Keyswitch in car-control station removes car from group operation and allows it to respond only to car calls. Key cannot be removed from keyswitch when car is in independent service. When in independent service, doors close only in response to door close button.
5. Priority Service: Service is initiated by a card reader at designated floors. One elevator is removed from group operation and directed to the floor where service was initiated. On arriving at the floor, elevator opens its doors and parks . Car is placed in operation by selecting a floor and pressing door close button or by operating keyswitch to put car in independent service. After responding to floor selected or being removed from independent service, car returns to group operation. If car is not placed in operation within a preset time after being called, it is returned to group operation.

C. Security Features: Security features do not affect emergency firefighters' service.

1. Card-Reader Operation: System uses card readers at car-control stations and hall push-button

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stations to authorize calls. Security system determines which landings and at what times calls require authorization by card reader. Provide required conductors in traveling cable and panel in machine room for interconnecting card readers, other security access system equipment, and elevator controllers. Allow space for card reader in car.

2. Keypad Operation: Allows each landing to be restricted or unrestricted. When a restricted landing button is pressed, a "Restricted Floor" lamp lights and remains lit until landing access code has been entered into a keypad or predetermined time period has elapsed. Car calls for restricted landings do not register until landing access code is entered into keypad within predetermined time period after landing button is pressed.

    a. Access codes are programmed at each car operating panel using a security keyswitch. Keypad operation can be activated and deactivated by security keyswitch at main landing.

3. Car-to-Lobby Feature: Feature, activated by keyswitch at main lobby, that causes car to return immediately to lobby and open doors for inspection. On deactivation by keyswitch, calls registered before keyswitch activation are completed and normal operation is resumed.

2.6 DOOR-REOPENING DEVICES

A. Infrared Array: Provide door-reopening device with uniform array of 36 or more microprocessor-controlled, infrared light beams projecting across car entrance. Interruption of one or more light beams causes doors to stop and reopen.

B. Nudging Feature: After car doors are prevented from closing for predetermined adjustable time, through activating door-reopening device, a loud buzzer sounds and doors begin to close at reduced kinetic energy.

2.7 CAR ENCLOSURES

A. Provide enameled- or powder-coated-steel car enclosures to receive removable wall panels, with removable car roof, access doors, power door operators, and ventilation.

1. Provide standard railings complying with ASME A17.1/CSA B44 on car tops where required by ASME A17.1/CSA B44.

B. Materials and Finishes: Manufacturer's standards, but not less than the following:

1. Subfloor:

    a. Exterior, underlayment-grade plywood, not less than **5/8-inch** nominal thickness.

2. Stainless Steel Wall Panels: Flush, formed-metal construction; fabricated from stainless steel sheet.
3. Fabricate car with recesses and cutouts for signal equipment.
4. Fabricate car door frame integrally with front wall of car.
5. Stainless Steel Doors: Flush, hollow-metal construction; fabricated from stainless steel sheet.
6. Sight Guards: Provide sight guards on car doors.
7. Sills: Extruded or machined metal, with grooved surface, **1/4 inch** thick.
8. Luminous Ceiling: Fluorescent light fixtures and ceiling panels of translucent acrylic or other permanent rigid plastic.
9. Ceiling: Metal flush panels, with four low-voltage downlights in each panel. Align ceiling panel joints with joints between wall panels.

2.8 HOISTWAY ENTRANCES

A. Hoistway Entrance Assemblies: Manufacturer's standard horizontal-sliding, door-and-frame hoistway entrances complete with track systems, hardware, sills, and accessories. Frame size and profile accommodate hoistway wall construction.

1. Where gypsum board wall construction is indicated, frames are self-supporting with reinforced head sections.

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B. Fire-Rated Hoistway Entrance Assemblies: Door-and-frame assemblies comply with NFPA 80 and be listed and labeled by a testing and inspecting agency acceptable to authorities having jurisdiction based on testing at as close-to-neutral pressure as possible according to NFPA 252.

1. Fire-Protection Rating: 1 hour.

C. Materials and Fabrication: Manufacturer's standards, but not less than the following:

1. Stainless Steel Frames: Formed from stainless steel sheet.
2. Stainless Steel Doors and Transoms: Flush, hollow-metal construction; fabricated from stainless steel sheet.
3. Sight Guards: Provide sight guards on doors matching door edges.
4. Sills: Extruded or machined metal, with grooved surface, **1/4 inch** thick.
5. Nonshrink, Nonmetallic Grout: Factory-packaged, nonstaining, noncorrosive, nongaseous grout complying with ASTM C1107/C1107M.

2.9 SIGNAL EQUIPMENT

A. Provide hall-call and car-call buttons that light when activated and remain lit until call has been fulfilled. Provide vandal-resistant buttons and lighted elements illuminated with LEDs.

B. Car-Control Stations: Provide manufacturer's standard recessed car-control stations. Mount in return panel adjacent to car door unless otherwise indicated.

1. Mark buttons and switches for required use or function. Use both tactile symbols and Braille.
2. Provide "No Smoking" sign matching car-control station, either integral with car-control station or mounted adjacent to it, with text and graphics as required by authorities having jurisdiction.

C. Swing-Return Car-Control Stations: Provide car-control stations mounted on rear of hinged return panel adjacent to car door and with buttons, switches, controls, and indicator lights projecting through return panel but substantially flush with face of return panel.

1. Mark buttons and switches for function. Use both tactile symbols and Braille.
2. Provide "No Smoking" sign matching car-control station, either integral with car-control station or mounted adjacent to it, with text and graphics as required by authorities having jurisdiction.

D. Emergency Communication System: Two-way voice communication system, with visible signal, which dials preprogrammed number of monitoring station and does not require handset use. System is contained in flush-mounted cabinet, with identification, instructions for use, and battery backup power supply.

E. Firefighters' Two-Way Telephone Communication Service: Provide flush-mounted cabinet in each car and required conductors in traveling cable for firefighters' two-way telephone communication service specified in Section 284600 "Fire Detection and Alarm."

F. Car Position Indicator: Provide illuminated, digital-type car position indicator, located above car door or above car-control station. Also, provide audible signal to indicate to passengers that car is either stopping at or passing each of the floors served. Include travel direction arrows if not provided in car-control station.

G. Hall Push-Button Stations: Provide one hall push-button station at each landing.

1. Provide manufacturer's standard wall-mounted units.
2. Equip units with buttons for calling elevator and for indicating applicable direction of travel.

H. Hall Lanterns: Units with illuminated arrows; however, provide single arrow at terminal landings. Provide one of the following:

1. Manufacturer's standard wall-mounted units, for mounting above entrance frames.

I. Hall Annunciator: With each hall lantern, provide audible signals indicating car arrival and direction of travel. Signals sound once for up and twice for down.

1. At manufacturer's option, audible signals may be placed on cars.

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J. Hall Position Indicators: Provide illuminated, digital-display-type position indicators, located above hoistway entrance at ground floor.

1. Integrate ground-floor hall lanterns with hall position indicators.

K. Emergency Pictorial Signs: Fabricate from materials matching hall push-button stations, with text and graphics as required by authorities having jurisdiction, indicating that in case of fire, elevators are out of service and exits should be used instead. Provide one sign at each hall push-button station unless otherwise indicated.

2.10 FINISH MATERIALS

A. Cold-Rolled Steel Sheet: ASTM A1008/A1008M, commercial steel, Type B, exposed, matte finish.

B. Hot-Rolled Steel Sheet: ASTM A1011/A1011M, commercial steel, Type B, pickled.

C. Stainless Steel Sheet: ASTM A240/A240M, Type 304.

D. Textured Stainless Steel Sheet: ASTM A240/A240M, Type 304, with embossed texture rolled into exposed surface.

1. Metal surface is satin polished after texturing.

E. Stainless Steel Bars: ASTM A276/A276M, Type 304.

F. Stainless Steel Tubing: ASTM A554, Grade MT 304.

G. Aluminum Extrusions: **ASTM B221**, Alloy 6063.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine elevator areas, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work. Verify critical dimensions and examine supporting structure and other conditions under which elevator work is to be installed.

B. Prepare written report, endorsed by Installer, listing conditions detrimental to performance of the Work.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION OF HYDRAULIC ELEVATORS

A. Install cylinder plumb and accurately centered for elevator car position and travel. Anchor securely in place, supported at pit floor. Seal between protective casing and pit floor with **4 inches** of nonshrink, nonmetallic grout.

B. Install cylinder plumb and accurately centered for elevator car position and travel. Anchor securely in place, supported at pit floor and braced at intervals as needed to maintain alignment. Anchor cylinder guides at spacing needed to maintain alignment and avoid overstressing guides.

C. Welded Construction: Provide welded connections for installing elevator work where bolted connections are not required for subsequent removal or for normal operation, adjustment, inspection, maintenance, and replacement of worn parts. Comply with AWS workmanship and welding operator qualification standards.

D. Sound Isolation: Mount rotating and vibrating equipment on vibration-isolating mounts to minimize vibration transmission to structure and structure-borne noise due to elevator system.

E. Lubricate operating parts of systems as recommended by manufacturers.

F. Alignment: Coordinate installation of hoistway entrances with installation of elevator guide rails for accurate alignment of entrances with car. Where possible, delay installation of sills and frames until car is operable in shaft. Reduce clearances to minimum, safe, workable dimension at each landing.

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G. Leveling Tolerance: **1/4 inch**, up or down, regardless of load and travel direction.

H. Set sills flush with finished floor surface at landing. Fill space under sill solidly with nonshrink, nonmetallic grout.

I. Locate hall signal equipment for elevators as follows unless otherwise indicated:

1. For groups of elevators, locate hall push-button stations between two elevators at center of group or at location most convenient for approaching passengers.
2. Place hall lanterns either above or beside each hoistway entrance.
3. Mount hall lanterns at a minimum of **72 inches** above finished floor.

3.3 FIELD QUALITY CONTROL

A. Acceptance Testing: On completion of elevator installation and before permitting elevator use (either temporary or permanent), perform acceptance tests as required and recommended by ASME A17.1/CSA B44 and by governing regulations and agencies.

B. Advise Owner, Architect, and authorities having jurisdiction in advance of dates and times that tests are to be performed on elevators.

3.4 PROTECTION

A. Temporary Use: Comply with the following requirements for elevator used for construction purposes:

1. Provide car with temporary enclosure, either within finished car or in place of finished car, to protect finishes from damage.
2. Provide strippable protective film on entrance and car doors and frames.
3. Provide padded wood bumpers on entrance door frames covering jambs and frame faces.
4. Provide other protective coverings, barriers, devices, signs, and procedures as needed to protect elevator and elevator equipment.
5. Do not load elevators beyond their rated weight capacity.
6. Engage elevator Installer to provide full maintenance service. Include preventive maintenance, repair or replacement of worn or defective components, lubrication, cleanup, and adjustment as necessary for proper elevator operation at rated speed and capacity. Provide parts and supplies same as those used in the manufacture and installation of original equipment.
7. Engage elevator Installer to restore damaged work, if any, so no evidence remains of correction. Return items that cannot be refinished in the field to the shop, make required repairs and refinish entire unit, or provide new units as required.

3.5 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to operate , adjust, and maintain elevator(s).

B. Check operation of elevator with Owner's personnel present before date of Substantial Completion and again not more than one month before end of warranty period. Determine that operation systems and devices are functioning properly.

3.6 MAINTENANCE

A. Initial Maintenance Service: Beginning at Substantial Completion, maintenance service includes 12 months' full maintenance by skilled employees of elevator Installer. Include monthly preventive maintenance, repair or replacement of worn or defective components, lubrication, cleaning, and adjusting as required for proper elevator operation. Parts and supplies are manufacturer's authorized replacement parts and supplies.

1. Perform maintenance during normal working hours.
2. Perform emergency callback service during normal working hours with response time of two hours or less.
3. Include 24-hour-per-day, 7-day-per-week emergency callback service with response time of two hours or less.

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END OF SECTION 14 24 00

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SECTION 21 10 00 - FIRE PROTECTION

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Connections and Fees.

B. Firelines, Extensions as shown on Drawings.

C. System Design Requirements per Jurisdictional Authorities.

D. Underground Exterior Piping as shown on Drawings.

E. Fire Hydrants as shown on Drawings.

F. Interior and Exterior above Ground Piping.

G. Sprinkler System.

H. Standpipe System.

I. Fire Department Connections.

J. Fire Pumps and Accessories.

K. All Alarms, Switches and Required Wiring.

1.2 RELATED REQUIREMENTS

A. The General Conditions, Supplementary Conditions and Division 1, General Requirements apply to this Section, and Contractor shall review and adhere to all requirements of these documents.

B. Section 230500 - Basic Mechanical Requirements.

C. The 211000 Contractor shall furnish all equipment, materials, tools, labor, engineering, drawings, etc. necessary for a complete sprinkler system ready for operation in accordance with the requirements of the authority having jurisdiction. The purpose of the furnished specifications and associated drawings is to convey to the Contractor the scope of work required, all of which the Contractor is responsible to furnish, install, adjust and make operable. The Contractor shall visit the site before submitting the bid, and shall examine all existing physical conditions which may be material to the performance of his work. No extra payments will be allowed to the Contractor as a result of extra work made necessary by his failure to do so. Any case of discrepancy or lack of clarity shall be promptly identified to the Owner's Representative and Engineer for clarification.

1.3 RELATED SECTIONS

A. Section 012300 - Alternates.

B. Section 230529 - Basic Mechanical Materials and Methods.

C. Section 230540 - Mechanical Sound and Vibration Control.

D. Section 212200 - FM-200 Extinguishing System.

E. Section 221410 - Plumbing Piping: Copper water piping.

F. Section 221411 - Disinfecting Water Supply System.

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G. Section 221430 - Plumbing Specialties: Pressure gauges, air gap fittings, pressure relief valves.

H. Section 231113 - Fuel Oil System.

1.4 FIRE LINES

A. The work of this section shall start at the water service entrance termination flange installed inside the building and above the floor by the site utilities contractor.

1.5 CONNECTIONS AND FEES

A. System development charges and or similar charges, that in principle allow the right to obtain the services from the utility will be arranged and paid for by the Site Utilities Contractor shall contact all jurisdiction authorities to verify fee requirement.

B. Tap fees as they are known to the trade and are the charges for actual materials and labor for tapping, inspection and recording of the tap shall be arranged and paid for by the Site Utilities Contractor.

C. In the event that the serving utility company installs their own taps, service, meters, etc., all costs imposed by this action shall be paid for by the Site Utilities Contractor. Extensions from termination points to connection with building services and systems will be the responsibility of the 211000 Contractor.

D. Be responsible for all pads, vaults, manholes, manhole covers, valve enclosures, valves, services boxes, and required material, all in conformance with requirements of the serving utility company.

E. Contractor shall coordinate with other trades all interface piping and types of connections to be provided for interface.

F. Permit fees shall be provided in the base bid. The 211000 Contractor shall furnish the Owner with a copy of all official documents and written correspondence associated with permits.

1.6 DEFINITIONS

A. The following are references with definition acronyms used in this section:

1. U.L. - Underwriters Laboratory Listed for Fire Protection Systems.
2. F.M. – FM Global or Factory Mutual Research.
3. IRI - Industrial Risk Insurors (aka: F.I.A. Factory Insurance Association.)
4. NFPA - National Fire Protection Association.
5. Jurisdictional Agencies:

    a. Building Department.
    b. Fire Department or Fire Prevention Bureau or Marshal.
    c. Insurance Agency, Carrier, and/or Underwriter as defined in Section 1.7.

6. Engineer refers to the consulting Mechanical Engineer of record.
7. Pipe sizes used in this Specification are Nominal Pipe Size (NPS).
8. Other definitions for fire protection systems are listed in NFPA 13.
9. Working Plans as used in this Section mean those documents (including drawings and calculations) prepared pursuant to the requirements contained in NFPA 13 for obtaining approval of the authority having jurisdiction.
10. Review and Approval will be only for conformance with the design concept of the Project and for compliance with the information given in the Contract Documents and shall not extend to means, methods, techniques, sequences or procedures of construction (except where a specific means, method, technique, sequence or procedure of construction is indicated in or required by the Contract Documents) or to safety precautions or programs

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incident thereto. The review and approval of a separate item as such will not indicate approval of the assembly in which the item functions.

1.7 SYSTEM DESIGN REQUIREMENTS

A. Sprinkler System Requirements:

1. Provide a dry-pipe sprinkler system to protect the entry canopy, air handler and similar areas subject to freezing.
2. Provide a freeze-protected sprinkler system using dry sprinkler heads or charged with U.S.P. glycerin or propylene glycol to protect and similar areas subject to freezing.
3. Provide a wet pipe sprinkler system to protect all other areas of the building, laboratories and vocational shops, and similar areas as required by code.
4. Sprinkler heads shall be centered in ceiling tiles in all finished areas.
5. Provide inspector test valve and piped drain at each riser.

B. Occupancy hazard classifications shall be determined in accordance with NFPA 13 unless higher hazard classifications are indicated on the drawings or required by insurance underwriter or jurisdictional authority.

C. Fire protection shall be designed and installed per NFPA 13 and NFPA 14 current published standards and local Jurisdictional Agency requirements. Where a conflict occurs the more stringent standard shall apply.

D. Verify requirements with Jurisdictional authorities, i.e.: Insurance Co. or Underwriter (when specified above), Fire Department or Marshal, or Building Department. Provide system complete, functional and acceptable to Jurisdictions without penalty of any type to the insurance premium rate. Division 211000 Contractor shall coordinate his work with all other sections of these specifications and drawings. No change order will be issued for lack of coordination or lack of verification of requirements of Jurisdictional Authorities.

E. System shall be hydraulically calculated per Jurisdictional Agency Standards.

F. All calculations shall include flow test results. Flow tests shall be performed by this Contractor and submitted to the Fire Department. Prior flow tests on file with jurisdictional agencies may be used in lieu of new flow tests only when previous test has been made within 3 months of project start date.

G. The system shall be designed to account for seasonal changes and for future degradation of the water supply system, using previous seasonal flow tests from the water utility to determine the expected range of pressure fluctuation at the project site.

H. Be responsible for accurate measurements, coordination with other trades, required offsets, scheduling, timely submittals, material delivery, job manning, and conformance to construction schedules.

I. Provide backflow protection in accordance with jurisdictional requirements. <Provide back flow preventers of required types, and installed in an approved manner above or below grade as applicable. Backflow devices in pits or vaults below ground will not be acceptable unless the pit or vault is free draining, provided with a floor drain piped to atmosphere without the aid of mechanical pumps or devices. Outfall for drain must be installed in non flood and non submersible positions. Backflow devices above grade shall be protected with self regulating thermostat controlled heat cable, approved for fire service by the jurisdictional authority, and shall not be less than 15 watts/lineal foot installed with required pitch. Insulate with 2" fiber glass with all service jacket and cover with weatherproof aluminum protective jacket. Heat cable shall be as manufactured by Raychem "Auto Trace". Backflow preventer shall be as manufactured by "FEBCO" or "BEECO". Refer to Sections 230529 and 221430 for specifications for Heat Trace and Backflow Preventers. Verification as to acceptance by jurisdictional authority and fire insurance underwriter shall be the responsibility of this Contractor.

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J. All areas shall be classified in accordance with NFPA 13 with respect to hazard classification and shall have automatic sprinkler systems designed for the appropriate classification.

K. Fire Protection Contractor shall furnish and install all alarm and supervisory switches or devices required for the automatic sprinkler system, fire pump and jockey pump, installed so as to provide an electrically supervised system.

L. The number and location of fire department connections shall be coordinated with the Architect and local Fire Department. The fire department connections shall be piped directly into the building fire protection loop or standpipe system.

M. Each sprinkler riser control valve shall be equipped with a valve supervisory switch and a waterflow switch on piping down stream of the last control valve. Drain piping for each fire protection riser shall be sized and located to accommodate full flow from the main drain under normal system pressure.

N. This project is located within a seismic zone which is subject to earthquakes. Sprinkler systems shall be protected per NFPA 13 to prevent breakage.

1.8 QUALITY ASSURANCE

A. The firm, company, corporation, or partnership producing and providing the material and labor of this Section shall have at least 3 years experience performing scope of work described and required by these Contract Documents.

B. Acceptable Fire Protection Contractors meeting the above requirements are as follows:

1. Delta Fire Protection, Salt Lake City, UT
2. Alta Fire Protection, Salt Lake City, UT
3. Fire Engineering Company, Salt Lake City, UT
4. Chaparral Fire Protection, Salt Lake City, UT
5. Firetrol Protection Systems, Salt Lake City, UT
6. Grinnell Fire Protection, Salt Lake City, UT
7. Western Automatic Sprinkler, Salt Lake City, UT
8. Preferred Fire Protection Company, Salt Lake City, UT
9. Aurora Fire Protection, Salt Lake City, UT
10. Shilo Automatic Fire Sprinkler, ID

C. Contractors not listed must submit for acceptance 10 calendar days prior to bid date. Proof of prior experience for Contractors not listed shall be submitted to the Engineer in writing, giving total and complete information of dates, name, address of owner, and location of all projects completed during past 3 years with specific references as to Engineers, and prime contractors involved. List names of companies, phone numbers and project manager’s name.

D. Codes and Standards:

1. All work shall conform to the requirements of the currently adopted editions of the following NFPA Standards and Recommended Practices as appropriate for the type of service except as specifically noted in each Section:

   a. “Installation of Sprinkler Systems", NFPA 13.
   b. “Installation of Standpipe and Hose Systems", NFPA 14.
   c. “Installation of Fire Pumps", NFPA 20.
   d. "National Electrical Code", NFPA 70.
   e. "National Fire Alarm Code", NFPA 72.
   f. “Inspection, Maintenance and Testing of Water- Based Suppression Systems”, NFPA 25.

2. All building construction work shall conform to the currently adopted edition of the International Building Code and International Fire Code.
3. All work shall conform to the federal, state and local regulations governing this installation.

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4. Should any conflicts occur between any code or standard, the most stringent requirement(s) shall apply.
5. The Fire Protection Contractor shall be subject to the interpretation of statutory requirements by the local Fire Department. Acceptance of the completed systems by the local Fire Department is required.

1.9 TECHNICAL SUBMITTALS

A. Timely submittals are essential to on-time completion of the project. The Owner will incur no obligation to extend the contract completion date, or to reduce or waive any liquidated damages due, as a result of the Fire Protection Contractor's failure to provide the specified submittals in a timely and acceptable fashion.

B. The information shown on each technical submittal shall be complete with respect to quantities, dimensions, specified performance and design criteria, products, materials, and similar data to enable the Owner, Engineer and Architect to review the information as required. Only complete submittals will be reviewed. Incomplete submittals will be rejected and returned to the Fire Protection Contractor without being reviewed.

C. Each technical submittal shall include a cover letter providing a description of each variation that the submittal may have from the requirements of the Contract Documents. In addition, the Fire Protection Contractor shall provide specific notation on each Working Plan, sample, catalog cut, data sheet, installation manual, etc. submitted for review and approval, of each such variation.

D. No construction or installation will be authorized until the required submittals are received and reviewed by the Owner, Engineer, and Architect. Any construction or installation performed without written authorization from the Owner shall be entirely at the Fire Protection Contractor's own risk.

E. The required Technical Submittals for all systems and equipment installed in accordance with these specifications include:

1. Working Plans, per NFPA 13.
2. Water Supply Information, per NFPA 13.
3. Hydraulic Calculations, per NFPA 13.
4. Operation and Maintenance Manual.
5. Test Protocols.
6. Fire Protection Contractor’s Material & Test Certificates for Aboveground Piping and for Underground Piping, per NFPA 13.
7. Record Drawings.

F. Provide six copies of each required Working Plan, manufacturer’s data sheet, water supply information, hydraulic calculations, and test protocol submittal within 60 days of award of contract.

G. Provide two copies of each required Operation and Maintenance Manual, Material & Test Certificates, and Record Drawing submittal a minimum of 10 working days prior to final acceptance testing.

H. All drawings and diagrams shall be CAD generated using AutoCAD Version 2013, prepared on drawing sheets 30" x 42"in size, and shall contain no extraneous information. Marked up copies of catalog data sheets or manufacturer’s “typical” diagrams are not acceptable in lieu of the required drawings or diagrams. All other information required for this submittal shall be submitted in one or more appropriately labeled and indexed 3-ring binders.

I. All drawings and diagrams shall include the Fire Protection Contractor's title block, complete with drawing title, Fire Protection Contractor's name, address, date (including revisions), and preparer's and reviewer’s initials.

J. Upon approval of the Working Plans, including completion of any required revisions, the Fire Protection Contractor shall provide one (1) complete, reproducible set and three blueline sets for the Owner, Engineer, and Architect’s use in performing field observations during construction.

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K. Working Plans for sprinkler systems shall be complete and in full accordance with NFPA 13 Chapter on Plans and Calculations.

1. All drawings and calculations shall be reviewed and accepted by the jurisidictional fire department, building department fire marshal, as applicable, and the insurance carrier or insurance reviewing authority prior to submitting to the Engineer. Indication of review and acceptance by all agencies, as appropriate, shall be certified by name of reviewer, agency, and date affixed to the plans or reproducibles submitted to the Engineer. None will be accepted or reviewed until compliance with these terms has been established.

L. Operation and Maintenance Manuals shall be prepared specifically for this project and bound in an indexed 3-ring binder, containing:

1. A detailed description of routine maintenance and testing as required and recommended and as would be provided under a maintenance contract, including a testing and maintenance schedule and detailed testing and maintenance instructions for each type of device installed. This description shall include:

   a. A listing of the individual system components that require periodic testing and maintenance.
   b. Step-by-step instructions detailing the requisite testing and maintenance procedures and the intervals at which those procedures should be performed, for each type of device installed. These instructions shall include copies of NFPA 25 - Inspection, Testing and Maintenance of Water-Based Fire Protection Systems and NFPA 72 - National Fire Alarm Code.

2. A schedule, which correlates the step-by-step testing and maintenance procedures with the listing of individual components. This schedule shall be completed for the duration of the warranty period or for one complete testing/maintenance cycle whichever is longer.
3. A service directory, including installing company's name and telephone numbers for whoever should be called to obtain both normal warranty service and 24-hour emergency service.
4. Drawings and diagrams, as required.
5. System Calculations.
6. Test reports for system, flow rates, and residual pressures.
7. Certified pump curves (all pumps).
8. Wiring diagrams for all system devices.

M. Upon completion of the installation, submit Record Drawings and Contractor's Material & Test Certificates for Aboveground Piping and for Underground Piping, per NFPA 13.

N. Record Drawings shall include all variations from the approved Working Plans, for whatever reason, including those occasioned by modifications, change orders, optional materials and/or required coordination between trades. Variations shall be indicated in sufficient detail to accurately reflect the as-built conditions. Upon completion of the work, before final acceptance, the Fire Protection Contractor shall deliver to the Owner, two (2) additional full size sets of blue lines and one set of AutoCAD drawing data files.

1.10 PROJECT CONDITIONS

A. Contractor shall not install any piping until he has assured himself that the piping can be run as contemplated in cooperation with Contractors of other Divisions of the Work and the physical constraints of the Structural and Architectural Work.

1.11 WARRANTIES

A. Provide original copies of all warranties and extended warranties for specific equipment where specified and in accordance with Section 230500.

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PART 2 - PRODUCTS

2.1 PRODUCT LISTINGS AND APPROVALS

A. All system components for which UL listings categories exist shall be listed by Underwriters Laboratories (UL) or Factory Mutual Research (FM).

1. All components shall be listed in the current edition of the UL Fire Protection Equipment Directory. Components shall be delivered to the project site with factory applied UL stickers.
2. Components for which UL listing approvals are “pending” are not acceptable.

B. All system components shall be used in accordance with the manufacturer’s recommendations and their listing.

C. All system components are subject to the approval of the engineer with regard to their fitness for the intended application.

2.2 UNDERGROUND EXTERIOR PIPING

A. Pipe, Fittings and Joints, Exterior and Buried:

1. General: The use of cast-iron, asbestos cement, steel, or other piping materials and systems is prohibited, unless specifically accepted by the Engineer.

2. Pipe Fittings and Joints:

a. Ductile iron pipe with mechanical joint fittings. Joints to be provided with set screw retainer glands.

Make:	U.S. Pipe Company
Size:	2" thru 48"
Laying Condition:	Type 1
Thickness Class:	50 or 51 as required by U.S. Pipe.
Standards:	ANSI A21.SD/A21.51 AWWA C-150/151, U.L., F.M., NSF.
Pressure Rating:	250 psi
Fittings:	Ductile iron conforming to ANSI A21.10/A21.16 and AWWA C-110/111.
Retaining Glands:	Set screw type ductile.
Hydrant Connections:	Tee DI rotatable x MJ Hydrant Connector. DI rotatable 13" long x MJ

3. Polyvinylchloride pipe with mechanical joint, ductile fittings, and joint restraints:

Make:	Manville "Blue Brute".
Size:	4" thru 12"
Laying Condition:	Type 1 as defined by U.S. Pipe Co.
Class:	200 (DR 14) as determined by dia. of pipe O.D. divided by the wall thickness (SDR method) conforming to ASTM D-1599 burst test (985 psi minimum) and minimum 100 ft-lbs of impact per ASTM D-2444. Meet all requirements of AWWA C-900, U.L., F.M., and N.S.F.
Pressure Rating:	200 psi minimum operating @ 73 deg. F

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Fittings:	Ductile iron conforming to ANSI A21.10/A21.11 and AWWA C-110/111 Mechanical Joint pattern only.
Retaining Glands:	Do not use set screw retaining glands on this pipe. Use felt padded pipe clamps, coated rods, and concrete thrust blocks for all turns, offsets, and fittings.

Note: Straight lengths of piping, not offset or deflected, may be J-M "Ring Tite" locked joints in lieu of mechanical joint ductile iron connectors or fittings.

4. Fiberglass reinforced PVC pipe with mechanical joint ductile iron fittings, for use where pressures exceed 200 psi up to 350 psi:

Make:	Manville "Blue Brute".
Size:	4" thru 12"
Laying Condition:	Type 1 as defined by U.S. Pipe Co.
Class:	350 (4"=DR 32, 6" & 8"=DR 36, 10" & 12"=DR 41)
Pressure Rating:	350 psi minimum operating @ 73 deg. F
Fittings:	Ductile iron conforming to ANSI A21.10/A21.11 and AWWA C-110/111 Mechanical Joint pattern.
Retaining Glands:	Do not use set screw retaining glands on this pipe. Use felt padded pipe clamps and coated rods and concrete thrust blocks for all turns, offsets, and fittings.

Note: Straight lengths of piping not offset or deflected may be J-M "Lock-ring" joints in lieu of mechanical joint fittings or connectors.

5. Rotatable Fittings:

   a. Provide for all service risers, fire hydrants and valves, U.S. Pipe Company U-591 and U-592 MJ x PE or rotatable MJ gland tees and connecting pieces to provide plumb and true hydrant, valve and service riser settings.

B. Tapping Tees and Valves:

1. Where the water utility does not install its own service tap, provide tapping tees and valves for wet taps. Provide service saddle, valve, and service box with indexed cover in accordance with the utility's standards.

C. Backflow Preventer: Provide backflow preventer in accessible free draining pit or vault, or above ground in heated enclosure or area, or above ground heat traced with self regulating cable, in accordance with Section 230529.

1. Double check assembly, U.L. Classified, FM Approved, with shut-off valves. Ames C200, or approved equal.
2. Reduced pressure assembly, U.L. Classified, FM Approved, with shut-off valves. Ames C400, or approved equal.

D. Thrust Blocks - Tie Rods:

1. Provide 3000 lb type II concrete thrust blocks with soil contact area based on not more than 2000 psf horizontal soil bearing quality, and enveloping 1/2 of pipe, fitting, or valve. Provide saddle reinforcing as required.
2. Submit calculations for each thrust block and dead man provided.

   Provide 1/2" minimum machine thread rods and clamps (felt padded clamps for plastic pipe) on all service entries from last joint underground to riser elbow or wall entry and to first joint in the building. All rods, clamps, and bolts double coated with "ZRC" brand cold galvanizing coating after installation and draw up. Provide 1 coat of coal tar coating over

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galvanizing. NOTE: Clamps and rods to not preclude the requirements for thrust blocks or deadmen.

E. Cathodic Protection:

1. Provide 8 mil thick minimum polyethylene pipe wrap, overlap at joints and seal joint with 2" wide minimum polyethylene tape triple wrapped and extending at least 6" both ways beyond joint seam or provide machine wrapped scotchwrap #51 PVC tape with 50% overlap wrap on pipe primed with scotchwrap primer. Double wrap all fittings to 6" beyond fitting onto pipe. Provide primer on fittings, bolts, and nuts prior to wrapping.

2.3 SOLVENTS FOR PLASTIC PIPING

A. Solvents for plastic piping joints shall be certified to meet SCAQMD Rule 1168/316A. This includes but is not limited to PVC, CPVC, and ABS piping, all grades and sizes.

2.4 FIRE HYDRANTS

A. Provide hydrants of 3-way pattern with two 2-1/2" hose nozzles, one 4-1/2" pumper nozzle, 5-1/4" nominal main valve pening, MJ inlet connection. Opening direction, operating nut, and nozzle threading shall conform with local jurisdictional regulations. Verify these items prior to order and installation. Bury depth to be below local frost/freeze depth. Hydrant to be dry top-traffic pattern and painted (color coded) per local standards. Hydrants U.L.-FM approved where applicable.

2.5 INTERIOR AND EXTERIOR ABOVE-GROUND PIPING

A. Pipe and Joints:

1. Black steel and galvanized steel threaded or roll grooved schedule 40 conforming to ASTM A-135 or A-53. Light wall (Schedule 10) conforming to ASTM A-135 or ASTM A-795, where prior approval is obtained from Owner and jurisdiction having authority. All pipe shall conform to NFPA #13, Chapter 3 and Jurisdictional Authorities and Insurance Agency. Where required to meet insurance agency or jurisdictional requirements, all dry pipe system and drain piping shall be galvanized.

B. Fittings:

1. Threaded cast iron, pressure class in accordance with developed system pressures, conforming to ASME B16.4. Threaded malleable iron, pressure class in accordance with developed system pressures, conforming to ASME B16.3. Threaded ductile iron, pressure class in accordance with developed system pressures, contforming to ASTM A-536 and ASME B 16.3.
2. Weld type fittings: Buttweld conforming to ASME B16.9. Flanges conforming to ASME B16.25. Socket weld conforming to ASME B16.11. All welds by certified welder in accordance with Section 230529.
3. Grooved fittings shall conform to ASTM-A47 (malleable), ASTM 536 (ductile), or ASTM-106 GRB (forged steel), ASTM A-53 type E, F, or S GRB (nipples), ASME B-16.5 or B16.1 cast iron and carbon steel flanges.

C. Flexible Connectors:

1. Flexible connector to be stainless steel (304) corrugated tube surrounded with stainless steel (304) wire braid. Provide threaded fittings on each end of the flexible connector.
2. Connector shall have the frictional equivalent of a maximum of 23 ft. of 1” steel pipe (assumes 4’ long tube with four 90° bends).
3. Connectors shall be UL listed, F.M. approved.
4. Provide with support bracing and clamps.

D. Valves:

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1. All valves are to be indicating type.
2. All valves U.L. listed, F.M. approved.
3. Refer to Section 230529 for valve specifications.

E. Hangers:

1. All hangers, attachments and components U.L. listed, F.M. approved.
2. All piping hangers shall conform to Jurisdictional Authorities requirements.
3. Powder driven studs shall not be included in normal installation. Permission to use this type anchoring system must be accepted by the Structural Engineer prior to submitting pricing or bids to any contractor or agent relative to this project.

2.6 SPRINKLER SYSTEM

A. Acceptable Manufacturers: The following manufacturers are acceptable, providing the product to be considered is equivalent in every respect to the nomenclature, style, material, finish, and color provided by the specified make and model.

1. Sprinkler Heads, Alarm, Dry and Deluge Valves, Accelerators, Detector Check Valves, Alarm Horn/Strobe, Air Maintenance Devices, Sprinkler Emergency Cabinets, and Specialties: Automatic, Central, Grinnell, Gem, Reliable, Viking, Notifier, Victaulic, Croker, Potter, Elkhart, Star.

B. Sprinkler Heads:

Heads shall be U.L. Listed and of the type required to properly protect the intended space. Heads shall be of ordinary-temperature classification except as required by ceiling temperature, location, or service as allowed or required by code. Provide quick-response heads in all light hazard occupancies.

LOCATION	ORIENTATION	HEAD FINISH	COVER OR ESCUTCHEON
Office	Recessed	Chrome	White
Conference Rooms	Recessed	Chrome	White
Elevator Lobbies	Recessed	Chrome	White
Classrooms	Recessed	Chrome	White
Entry Lobby	Concealed	Brass	White
Storage	Recessed	Brass	Chrome
Corridors	Recessed	Brass	White
Open Areas (No Ceilings)	Upright/Pendant	Brass	-
Equipment Rooms	Upright/Pendant	Brass	Chrome
Walk-in Cooler/Freezer	Dry	Brass	Chrome

C. Escutcheons shall be part of the U.L. Listed sprinkler assembly.

D. Sprinkler Head Cabinets:

1. Steel with red enamel finish for 6, 12, or 24 heads complete with appropriate heads, wrench and mounting.

E. Sprinkler Head Guard:

1. Steel wire cage, chrome finish.

F. Water Flow and Pressure Switches:

1. Paddle Type Flow Switch U.L. Listed, for pipe sizes 1" thru 8", for vertical or horizontal mounting, retard adjustment from 0 to 70 seconds instantly recycling, 10 amp, 120v AC, dual contacts. Notifier Model WFD, or approved equal.

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2. Pressure Switch for dry, deluge, alarm, and pre-action valves, U.L. Listed, 10 amp, 120v AC, dual contacts. Potter Model PS40A, or approved equal.

G. Supervisory Switches:

1. Post indicator valve, and gear operator type, U.L. Listed, weatherproof metal housing, threaded conduit entrance, 10 amp, 120v AC, dual contacts. Notifier Model PIBV2, or approved equal.
2. Gate, OS&Y, and other exposed rising stem type valves, U.L. Listed, weatherproof metal housing, threaded conduit entrance, 10 amp, 120v AC, dual contacts. Notifier Model OSY2, or approved equal.

H. Alarms:

1. Exterior Audible and Visual Alarm, U.L. Listed for outdoor use, weatherproof faceplate, horn and strobe. Notifier Model GMS, or approved equal.

I. Alarm Valves, Wet Pipe System: U.L. Listed, alarm check valve. Central Model F & G, or approved equal.

1. Provide with pressure switch variable pressure trim with retard and closed retard drain for use with pressure switch as required.

J. Dry Pipe Valve: U.L. Listed, control valve. Central Model AF & AG, or approved equal.

1. Provide as required, complete with all trim and drain extensions, for use with pressure switch as indicated.
2. Accelerator: U.L. Listed, complete with trim. Central Model B, or approved equal.
3. Air Maintenance Device: Provide automatic air maintenance device for dry pipe valves . Provide all trim, switches, strainers, valves for complete functional unit.

2.7 STANDPIPE SYSTEM

A. Acceptable Manufacturers: The following manufacturers are acceptable, providing the product to be considered is equivalent in every respect to the nomenclature, style, material, finish and color provided by the specified make and model.

Hose cabinets, hose racks, valves and regulating valves: Croker, Moon, Elkhart, Potter, Powhattan, Sierra, Goodall, Allenco, Central, Grinnell, Gem, Reliable, Viking, Victaulic, Star.

B. Cabinets:

1. Fire Hose Cabinet: Recessed, wire glass window.

2. Fire Valve Cabinet: Recessed, wire glass window.
3.

C. Hose Valves: U.L. Listed, FM approved, globe type, rough brassfinish.

1. Provide pressure limiting valves for stand pipe outlets and sprinkler supply as required.

2.8 FIRE DEPARTMENT CONNECTION - INLET (SIAMESE)

A. Cast brass, single clapper, straight or angle style as indicated. Provide siamese connections of sizes, styles and patterns required, caps and chains, and wall plate.

B. Style: Exposed.

C. Finish: Cast Brass.

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2.9 WALL HYDRANT CONNECTION - OUTLET

A. Cast Brass, exposed type. Provide wall hydrant outlets of sizes, styles, and pattern required with inlet control valve and valve access.

B. Finish: Cast Brass.

C. Provide Index Plates "Wall Hydrant" - "Wall Hydrant Control Valve" as required.

2.10 ROOF MANIFOLD

A. Cast brass, straight or angle pattern. Provide roof manifold of size, style, and pattern required. Provide control valve, stem extension, wall or floor stand, index plate, and cap and chain, with valve body located in a heated space and a stem extension so valve can be manually operated by a person standing outside on the roof.

1. relief valve, suction and discharge gauges, coupling guard, suction and discharge reducers/increasers of types and styles as appropriate, splash partition.
2. Controller U.L. and F.M. approved, including starters as required, NEMA 3R enclosure, minimum run timer, remote shutdown interlock, hour meter, and all operation and alarm functions required by NFPA #20.

2.11 PRESSURE MAINTENANCE (JOCKEY) PUMP

A. Acceptable Manufacturers: Burks, Allis-Chalmers, Peerless, Aurora, Chicago, Armstrong.

PART 3 - EXECUTION

3.1 PREPARATION

A. Field Measurements: Verify all dimensions before proceeding with the work. Obtain field measurements for work required to be accurately fitted to other construction. Be responsible for the accuracy of such measurements and precise fitting and assembly of finished work. Prefabrication of systems is done at this Contractor's own risk.

B. Coordination: Coordinate all work and placement of components with other trades, thorough coordination of design and field installation is expected. Remedial field work may be required to eliminate conflicts and provide an acceptable finished product.

3.2 EXCAVATION, BACKFILL, CUTS AND RESTORATION

A. Provide all excavations and backfill in accordance with Section 230529 - Basic Mechanical Materials and Methods.

B. Cuts - Restoration:

1. All concrete, asphalt, or other hard permanent surface shall be saw cut. Turf areas shall be cut clean with straight edge.
2. Restore all planted, paved, and surfaced areas to original color, texture and condition, replanting where necessary and left in the same or better condition as was found existing.

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3.3 INSTALLATION

A. General: Provide a complete operable system designed and installed in accordance with applicable local, state, federal and jurisdictional codes, enforcement agencies and insurance rating or underwriting agencies.

B. All systems shall be drainable with proper drainage devices, and drain terminations either to exterior of building or to proper receptacles within building.

C. All systems shall be supported and braced for conformance to proper and applicable standards.

D. Care shall be taken with chrome plated or other polished finish components so that marring does not occur to the finish, and installation provides for a uniform pattern and true installation.

E. Where piping passes thru masonry units or concrete walls or floors or other building construction, sleeves may be used. Where exposed piping passes thru finished work, chrome plated, or other finish acceptable to Architect, split wall plates or escutcheons shall be installed to fit snugly around piping. Where rated walls are penetrated, approved safing shall be provided at each hole to assure effectiveness of construction as a fire stop.

F. All openings for piping should be anticipated and coordinated with General Contractor. Indicate such openings on the shop drawings. Any additional cutting of openings must be coordinated with the General Contractor.

G. Contractor shall complete the automatic fire sprinkler standpipe ready for operation, in all respects, as soon as possible. When system is complete and ready for continuous operation, activate the system for its intended use. After system has been activated for continuous use, water charges, if any will be paid for by the Owner.

H. Use no face bushings.

I. Furnish and install all wiring for all flow switches, tamper switches, exterior and interior alarm items furnished in this Section. This work may be subcontracted to the Division 26 Contractor if desired by the Section 211000 Contractor but the Section 211000 Contractor shall include the wiring costs in his bid.

J. Provide seismic restraints in accordance with Jurisdictional Agencies.

K. The sprinkler piping shall be concealed from view in all common and public areas with a finished ceiling. Exposed piping shall be cleaned and left ready for painting by others.

L. Provide seismic separation assembly in accordance with NFPA 13 where pipes cross building seismic separation joints or expansion joints.

3.4 PERFORMANCE

A. General: Systems shall be engineered and designed for proper densities, ease of maintenance and accessibility. Final main drain flow tests shall be made to prove system design and installation.

3.5 CLEANING

A. General: Flush all systems free of all debris and certify system clean and ready for use.

3.6 TESTING AND CERTIFICATE OF COMPLETION

A. The entire system shall be hydrostatically tested at not less than 200 psig for not less than 2 hours with 0 psig pressure drop. Tests shall be witnessed by the Architect's or General Contractor’s representative - mandatory.

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B. Obtain certificate of compliance and completion for jurisdictional agencies, as applicable and present to Owner - mandatory.

END OF SECTION 21 10 00

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SECTION 22 14 10 - PLUMBING PIPING

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Water Piping.

B. Soil, Waste and Vent Piping.

C. Storm Water Piping.

D. Acid Waste and Vent Piping.

E. Subsurface Drainage Piping.

F. Site Drainage Piping.

G. Compressed Air Piping.

H. Laboratory Vacuum Piping.

I. Distilled and Deionized Water Piping.

J. Testing.

1.2 PRODUCTS INSTALLED BUT NOT FURNISHED IN THIS SECTION

A. Solenoid valves for evaporative cooling systems specified in Section 237400 - Air Handling Systems on Roof.

1.3 RELATED REQUIREMENTS

A. The General Conditions, Supplementary Conditions and Division 1, General Requirements apply to this Section, and Contractor shall review and adhere to all requirements of these documents.

B. Section 230500 - Basic Mechanical Requirements.

1.4 RELATED SECTIONS

A. Section 230529 - Basic Mechanical Materials and Methods.

B. Section 230540 - Mechanical Sound and Vibration Control.

C. Section 230548 - Mechanical Seismic Control.

D. Section 230700 - Mechanical Insulation.

E. Section 211010 - Outside Fire Protection System.

F. Section 221411 - Disinfecting Water Supply System.

G. Section 221430 - Plumbing Specialties.

H. Section 224440 – Plumbing Fixtures.

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I. Section 224450 – Plumbing Equipment.

J. Section 224460 - Special Plumbing Equipment Systems.

K. Section 224476 - Swimming Pool Systems.

L. Section 232120 - Process Piping.

1.5 SUBMITTALS

A. Submit Product Data for the following items under provisions of the General Conditions of the Contract:

1. Water Piping, Fittings, and Joints.

PART 2 - PRODUCTS

2.1 WATER PIPE, TUBE, FITTINGS AND JOINTS

A. Exterior Buried:

1. Copper Tube, Fittings, and Joint Material:

   Copper tube ASTM B88 Type K shall be soldered to wrought or cast fittings using 95-5 class SnSb (Tin-antimony) solder.
   a. Wrought copper and bronze solder joint fittings shall conform to ANSI B16.22.

   b. Cast bronze solder joint fittings shall conform to ANSI B16.18.
2. Cast Iron Pipe Fittings and Joints:

   a. Gray cast iron pipe, centrifugally cast, 18/40 physicals, cement lined, mechanical joint, thickness class 23 minimum. 300 psi minimum working pressure "laying condition A" as designated by USA Standard A21.1 and 8 foot bury.
   b. Mechanical joints and fittings shall be furnished with set screw retaining glands and shall conform to ANSI/AWWA C110/A21.10 and ANSI/AWWA C111/A21.11.
   c. Mechanical joint fittings shall be Ductile Iron, 350 psi working pressure up to 24" size.

3. Ductile Iron Pipe Fittings and Joints:

   a. Class 150, ductile iron pipe centrifugally cast, thickness class 2, cement lined, mechanical joint, 350 psi minimum working pressure "laying condition A" as designated by USA Standard A21.51 and 8 foot bury.
   b. Mechanical joints and fittings shall be furnished with set screw retaining glands and shall conform to ANSI/AWWA C110/A21.10 and ANSI/AWWA C111/A21.11.

4. Polyvinylchloride Water Pipe, Fittings, and Joints:

   a. Rigid polyvinylchloride (PVC) pipe for potable water systems shall conform with NSF Standards #14 and #61. NSF pw logo shall be affixed (printed or molded) on all pipe fittings and joining materials. Materials shall meet requirements of cell classification 12454-A or -B per ASTM D-1784.
   b. Pipe to be IPS size conforming to ASTM D 2241, be provided with integral bell end steel reinforced gasket and comply with ASTM D 3139.
   c. Pipe markings shall include nominal and O.D. base sizes, PVC 1120, DR 21, AWWA pressure class 200, ASTM D 2241, manufacturer name or trademark, production code, and NSF seal, AWWA C-900, UL as appropriate.

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d. Certified 800 psi test, in accordance with AWWA loading criteria, must be furnished to the Engineer for supplied pipe.
e. Solvent cement to be low volatile organic compound (VOC) to meet South Coast Air Quality Management District (SCAQMD) Rule #1168. Product: IPS Weld-On #2700 or equal.

B. Interior Buried:

1. Provide type K annealed (soft) copper water tube conforming to ASTM B-88 with 95% tin 5% antimony solder joints using wrought fittings. No joints below grade. Provide continuous tube for all buried tubing using tube bends in lieu of fittings. Exterior tube may be coupled where requirements are in excess of standard mill lengths by using wrought pressure couplings with stops and silver solder brazed Joints. Lengths coupled in this manner, where necessary and acceptable to the Engineer, will meet the intent of the no fitting requirement of this Specification. Interior buried tube shall meet the same criteria and requirements.

C. Interior Tube Supported by Hangers and Clamps:

1. Provide ASTM B88 Type L hard drawn copper tube for all water distribution piping inside building/structure, with wrought copper fittings and couplers up to 6", cast brass or bronze fittings and couplers for sizes 6" and larger. Joints shall be 95-5 Class SnSb solder or Victaulic CTS roll-grooved couplers and fittings for 3” and larger tube.

2.2 SOIL DRAIN WASTE, VENT AND STORM PIPE FITTINGS AND JOINTS

A. General:

1. Cast iron pipe centrifugally cast service weight (SV) soil pipe with cast iron drainage fittings conforming to ASTM A 74. Joint materials and systems may be hub and spigot with neoprene gaskets and lubricant conforming to ASA-021 and ASTM C-564 SV pattern. Gaskets shall be equal to U.S. Pipe Company Veri-tite conforming to ASTM-C564 and pipe and fittings be certified in writing to the Engineer that the following criteria has been met, thru testing by a recognized independent testing laboratory. Cast iron hubless pipe and fittings conforming to ASTM A 888, CISPI 301. Hubless couplings shall conform to ASTM C 1277 for standard and ASTM C 1540 for heavy duty or CISPI 310. Pipe and fittings shall be marked with the collective trademark of the cast iron soil pipe institute or receive prior approval of the engineer.

   Criteria: Sizes 2" thru 6" shall withstand 15 psig hydrostatic pressure for 10 minutes with unrestrained joints, and no leakage, and using restrained joints must be able to withstand 25 psig air pressure and 40 psig hydrostatic pressure with no leakage. Offset joints shall withstand 1056 pounds of horizontal force without joint separation or detectable leakage.

   a. Polyvinylchloride (PVC) sewer pipe and fittings shall conform to DR-35, ASTM D3034, bell and spigot type with reinforced rubber ring gasket integral with bell joint, minimum pipe stiffness at 5% deflection is 46, material to meet ASTM D1784, D2444 and joint tightness in accordance with ASTM D3212.
   b. Solvent cement to be low volatile organic compound (VOC) to meet South Coast Air Quality Management District (SCAQMD) Rule #1168. Product: IPS Weld-On #2700 or equal.

B. Buried Pipe:

1. Provide SV hub and spigot cast iron pipe and fittings to 5'-0" beyond building excavation line, continue past this point with SV cast iron or XS vitrified clay to termination points with hub and spigot joints. At Contractor’s option and where approved by local jurisdiction, No-Hub standard weight cast iron pipe with either M-G couplings or heavy-duty stainless steel shielded couplings may be used in lieu of hub and spigot with Ty-Seal neoprene gaskets. The heavy-duty shielded couplings shall comply with ASTM C1540, with ASTM C564 neoprene gaskets, minimum 0.008” stainless steel shields with transverse corrugations across longitudinal corrugations, standard 304 stainless steel clamps and 305 stainless

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steel screws. Entire assembly shall be suitable for direct burial, be corrosion resistant, and accommodate pipe deflection.

C. Interior Pipe Supported By Hangers and Clamps:

1. Provide hubless cast iron pipe using hubless cast iron soil pipe couplings certified to withstand a minimum of 50 psi internal pressure. Where stack pressures may theoretically exceed 50 psi, use clamp all or heavy-duty couplings with restrained joints horizontal and vertical up to 80 psig. For pressures above 80 psi, use Schedule 40 ASTM A-120 galvanized steel pipe with threaded cast iron drainage fittings. Roll grooved schedule 40 pipe with Victaulic Style 77M galvanized couplers may be used on horizontal and vertical stacks and mains. Use Teflon tape or compound for all threaded joint make-up.
2. Sump pump discharge from the pump to the point the waste stream flows continuously via gravity shall be Schedule 40 galvanized steel pipe with NPT threaded joints and fittings.
3. Copper Waste, Vent and Soil Pipe and Fittings shall be prohibited on this project.

2.3 COPPER DRAIN, WASTE AND VENT TUBE ABOVE GROUND

A. Copper waste, vent and soil pipe and fittings will be acceptable for exposed piping in food service areas when conforming to the following:

1. Type DWV copper (ASTM B-306) with DWV pattern cast copper or brass solder joint fittings (ASA B16.23; ASTM B-62) and 50-50 Class Sn Pb soldered joints.

2.4 PLASTIC DRAIN, WASTE AND VENT PIPING

A. Plastic drain, waste and vent piping may be installed when in compliance with jurisdictional codes and this specification.

B. Plastic DWV may be either P.V.C. or A.B.S. as required by code and utilizing drainage pattern fittings.

C. P.V.C. (polyvinylchloride) pipe and fittings shall conform to ASTM D2665 with a flame spread rating of 25 or less and shall consist of Schedule 40 DWV pattern.

D. A.B.S. (acrylonitrile - butadiene - styrene) pipe and fittings shall conform to ASTM D2661, CS 270-65, Schedule 40 DWV pattern.

E. All plastic DWV piping shall bear the seal of the National Sanitation Foundation (N.S.F.). None will be accepted without this seal.

2.5 SOLVENTS FOR PLASTIC PIPING

A. Solvents for plastic piping joints shall be certified to meet SCAQMD Rule #1168/316A. This includes but is not limited to PVC, CPVC, and ABS piping, all grades and sizes.

B. Solvent cement to be low volatile organic compound (VOC) to meet South Coast Air Quality Management District (SCAQMD) Rule #1168. Product: IPS Weld-On #2700 or equal.

C. Product: IPS Weld-On #2700 or equal.

2.6 SUBSURFACE AND FOOTING DRAINS

A. See Specification Section 334600 for requirements.

B. Provide polyvinylchloride perforated pipe (ASTM D2729) with P.V.C. fittings and solvent weld joints. Provide four rows of 1/4" dia. holes on three inch staggered centers running parallel to the pipe axis. Rows shall be located 100 deg., 135 deg., 225 deg., & 260 deg. from vertical per Corps of Engineers VICKSBERG SPECIFICATION. Exceptions to hole size and locations will not be granted.

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2.7 SITE DRAINAGE PIPING (Exterior-Buried)

A. Provide the following:

1. Reinforced concrete pipe and fittings, Class II, Type 5 concrete for piping 12" and larger.
2. Polyvinylchloride pipe and fittings, NSF Labeled conforming to ASTM D-3034 SDR 35 with gasket and snap ring, ASTM D-3212.
3. Extra heavy cast iron pipe and fittings, Commercial Standard CS-188 with rubber gaskets conforming to ASTM C-564 XH.
4. Corrugated metal pipe equal to "Armco Asbestos Bond" per the following gauge schedule: 8" = 16 ga., 10" = 14 ga., 12" thru 15" = 12 ga., 18" thru 21" = 10 ga., and 24" thru 84" = 8 ga.

PART 3 - EXECUTION

3.1 WATER TUBE, FITTINGS AND JOINTS

A. General:

1. All copper tube and fittings shall be reamed and buffed prior to soldering or brazing.
2. The use of lead solder of any class, for joint make-up or back-up for finishing is prohibited.
3. Refer and conform to the Copper Development Association instructions for proper preparation and actual installation practice for all soldered and brazed joints.
4. Support water tube in accordance with Section 230529.
5. Pull tee (T-drill) fittings are forbidden.

3.2 PROTECTION

A. Protect installed work from damage due to subsequent construction activity on the site.

3.3 SOIL, DRAIN, WASTE, VENT AND STORM PIPE FITTINGS AND JOINTS

A. General:

1. Provide bedding, restraints and hangers as appropriate and in accordance with manufacturers recommendations based upon type of pipe, fittings, joints, and bury depth using final finished grading as the basis.
2. Piping shall be run true, plumb, and straight, with all restraints and hangers adjusted to carry their proportional load and locked to prevent pipe "wag" misalignment, movement or shear.
3. Provide anchors for piping risers on every floor using riser clamps, wall brackets, knee brackets, and foot blocks for all vertical piping over 20 feet straight height.
4. Furnish and install all soil, waste and vent piping for the complete sanitary system in accordance with jurisdictional code requirements.
5. All soil and waste piping shall be run at the following minimum slope unless otherwise indicated on drawings.

Slope of Horizontal Drainage Pipe	
Size (In.)	Min. Slope (In./Ft.)
2-1/2 or less	1/4
3 to 6	1/8
8 or larger	1/16

6. Bushings in soil waste or vent piping shall be prohibited. Tapped spigots or tees shall be used when changing from cast iron pipe to steel waste or vent piping, and for appropriate cleanout plugs.

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7. Vertical Piping: All vertical soil and vent stacks shall be supported with riser clamps at each floor slab. When soil stacks over two stories in height terminate at the bottom on slab fill or native soil, provide stack base elbows set on 24" x 24" x 8" thick minimum poured reinforced concrete pads set directly on undisturbed native soil or fill compacted to same density as undisturbed earth.
8. Horizontal Piping (suspended):

    a. Supports - Horizontal piping shall be supported at sufficiently close intervals to keep it in alignment and prevent sagging.
    b. Cast iron soil pipe - Where joints occur, suspended cast iron soil pipe shall be supported at not more than five (5) foot intervals; except that pipe exceeding five (5) feet in length, may be supported at not more than ten (10) foot intervals. Supports shall be adequate to maintain alignment and prevent sagging and shall be placed within eighteen (18) inches of the hub or joint. Hubless or compression gasket joints must be supported at least at every other joint except that when the developed length between supports exceeds four (4) feet, they shall be provided at each joint. Supports shall also be provided at each horizontal branch connection. Supports shall be placed on or immediately adjacent to the coupling. Suspended lines shall be suitably braced to prevent horizontal movement.
    c. Threaded pipe - Threaded pipe (IPS), shall be supported in accordance with Section 230529.
    d. Rigid support sway bracing shall be provided at changes in direction greater than 45 degrees for pipe sizes 4 inches and larger.
    e. For pipe sizes greater than 4 inches, axial restraints shall be provided for drain pipes at all changes in direction and at all changes in diameter greater than two pipe sizes.

9. The waste connections between fixtures and their respective collection and venting systems shall consist of galvanized steel nipples and cast iron drainage fittings.
10. All interior waste, soil, and vent piping up to 1-1/2" shall consist of galvanized steel with cast iron drainage fittings, all piping 1-1/2" and over shall consist of S.V. cast iron soil pipe and fittings.
11. All pipe and fittings shall have affixed thereon the CISPI grade mark of identification.
12. All vents shall be installed through the roof of at least the minimum size as required by jurisdictional code and shall be cast iron.
13. All vents protruding through the roof shall be not less than 2" size and extended to not less than 12 inches above the finished roof. Vents through built-up roofing shall be flashed with 24" x 24" x 4 lb. sheet lead. The flashing shall extend to top of vent and the edges turned down into a cast iron vent pipe. Single ply rubberized roofing systems shall be flashed around vent with top edge of roofing clamped to vent pipe and sealed with compatible sealant.
14. All vents shall be located in accordance with jurisdictional code and in no case less than two (2) feet from roof edge or parapet, or wall line of an "on the roof structure". Vent terminations shall not occur within twenty-five (25) feet of any outside air intake.
15. Vandal proof vent caps shall be installed on all sanitary vents extending through roofs which are accessible from ground level and on all roofs of elementary or secondary schools.
16. Provide all expansion joints, braces, earthquake restraints as required by the contract documents (Section 230548) and jurisdictional authority.
17. Buried No-Hub fittings shall not be allowed on this project.

3.4 PROHIBITED PIPE ROUTING

A. Plumbing piping, regardless of contents (water, sewer, vent, etc.) shall not be routed through or above the following locations:

    1. Electrical panel rooms
    2. Electrical switch gear rooms
    3. Electrical transformer rooms
    4. Elevator shafts
    5. Elevator equipment rooms

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6. Data Centers
7. File Server Rooms / MDF / IDF

B. Should there be a conflict with the plans and the above paragraph, notify the Engineer immediately for corrective action prior to starting work.

3.5 COPPER DRAIN, WASTE AND VENT TUBE

A. All soil and waste lines below ground floor or buried below grade shall be SV cast iron pipe and fittings with gasketed joints.

B. Vents shall be type DWV or L copper with cast copper or brass drainage pattern fittings and shall terminate at least 12" above the finished roof construction, and flashed with self sealing neoprene boots with integral lead or copper flashing pans.

B. Bushings for soil, waste, drainage, or vent lines shall not be used.

C. Provide 50-50 Class Sn Pb soldered joints.

D. Support vertical soil, waste, drainage, stacks and vents from building structure with padded riser clamps, allow for adequate expansion of all copper piping.

3.6 PLASTIC DRAIN WASTE AND VENT PIPING

A. Plastic piping shall be installed with caution towards expansion and contraction characteristics. The piping shall be free to flex and move without bindings. The pipe shall be securely anchored at the roof to prevent movement at the roof penetrations.

B. Roof penetrations shall be made with self-sealing neoprene boots with integral lead or copper flashing pans.

C. Provide solvent weld joints.

D. Solvent cement to be low volatile organic compound (VOC) to meet South Coast Air Quality Management District (SCAQMD) Rule #1168. Product: IPS Weld-On #2700 or equal.

E. Support vertical soil, waste, drainage stacks and vents from building structure with padded riser clamps.

3.7 SUBSURFACE AND FOOTING DRAINS

A. Provide perforated piping on gravel fill covered with drainage fabric to prevent dirt but not moisture from entering drainage openings.

B. Slope piping 1" per 30 feet minimum or as noted on drawings.

C. Provide flushing (rod out box) or cleanout access at each turn, at all ends, and at areas shown on drawings.

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3.8 TESTING

A. Schedule of Testing:

Service	Allowable Test Methods H_2O	CA	N_2	V	Minimum Test Pressure (psig)	Minimum Test Period (minutes)	Allowable Pressure Variance (psig)
1. Potable Water Pipe Valves & Fittings	X	X			125 100	60 60	-0- +1/2
2. Sanitary, Storm & Acid Waste and Vent System:							
*Stack Height:							
0-23 FT.	X				10	30	-0-
24-34 FT.	X				15	30	-0-
35-46 FT.	X				20	20	-0-
47-57 FT.	X				25	20	-0-
58-69 FT.	X				30	10	-0-
70-80 FT.	X				35	10	-0-
81-92 FT.	X				40	10	-0-
93-103 FT.	X				45	10	-0-
Over 104 FT.	X				50	10	-0-
3. Compressed Air:							
Single Stage Compressor		X	X		100	30	+ 1/2
Two Stage Compressor		X	X		200	30	+ 1/2
4. Vacuum:				X	-7.4 (15"Hg)	30	-0-
5. Distilled and Deionized			X		60	30	-0-

B. Testing connections for hydrostatic tests shall be made at the base of the system, CA, N2 and vacuum testing can be made from connections anywhere in the system tested.

C. In the event that tests fail, use a standard soap and brush inspection using "Trouble Bubble" Liquid high density soap as manufactured by Jersey Meter Co., Patterson N.J. Formula ST-1. After source of failure is discovered, correct and retest system. Repeat procedure until system sustains required testing successfully.

D. Testing contractor shall give at least 16 working hours notice to the General Contractor/Construction Manager so that arrangements for witnessing tests can be made. The General Contractor/Construction Manager shall witness and SIGN the required test form.

E. All joints, valves, fittings and piping accessory items shall be exposed to view during tests whether pipe is above or below ground. "Closed in" or "Buried" piping shall be re-exposed during testing.

F. Proper restraining of piping and test plugs shall be accomplished prior to test.

END OF SECTION 22 14 10

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SECTION 22 14 11 - DISINFECTING WATER SUPPLY SYSTEM

PART 1 - GENERAL

1.1 WORK INCLUDED

A. Disinfection of Domestic Water Supply System.

1.2 RELATED WORK

A. Requirements: Provide Disinfecting Water Supply System in accordance with the Contract Documents.

B. Section 230500 - Basic Mechanical Requirements.

C. Section 221410 - Plumbing Piping.

1.3 DEFINITIONS

A. Disinfectant residual means the quantity of disinfectant in treated water.

B. pH factor means the measure of alkalinity and acidity in water.

C. ppm means parts per million.

1.4 CONTRACTOR'S QUALIFICATIONS

A. Water Treatment Contractor: At least three years experience performing work specified herein.

B. Bacteriological Laboratory: Certified by Serving Water Board or District and be in compliance with the State and U.S. Safe Drinking Water Act.

1.5 REGULATORY AGENCY REQUIREMENTS

A. Comply with requirements of Local and State Regulations.

1.6 SUBMITTALS

A. Submit for review and acceptance the following items under provisions of the General Conditions of the Contract:

1. Water treatment contractor's evidence of experience.

B. Submit printed data for the following items under provisions of Operating and Maintenance Data paragraph in Section 230500:

1. Disinfection Report:

a. Include the following:

Date issued.

Project name and location.

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Treatment Contractor's name, address, and phone number.

Type and form of disinfectant used.

Time and date of disinfectant injection start.

Time and date of disinfectant injection completion.

Test locations.

Initial and 24 hour disinfectant residuals in ppm for each outlet tested.

Time and date of flushing start.

Time and date of flushing completion.

Disinfectant residual after flushing in ppm for each outlet tested.

2. Bacteriological Report:

a. Include the following:

Date issued.

Project name and location.

Laboratory's name, certification number, address and phone number.

Time and date of water sample collection.

Name of person collecting samples.

Test locations.

Time and date of laboratory test start.

Coliform bacteria test results for each Outlet tested. Certification that water conforms or fails to conform to bacterial standards of State and Federal Safe Drinking Water Act.

Bacteriologist's signature.

1.7 PRODUCT DELIVERY, STORAGE, AND HANDLING

A. Protect against damage and discoloration.

B. Maintain caution labels on hazardous materials.

C. Maintain storage room dry and with temperatures as uniform as possible between 60 deg.F and 80 deg.F.

D. Do not store Caustic Soda directly on floor colder than 55 deg.F.

1.8 PROTECTING WORK OF OTHER TRADES

A. Provide necessary signs, barricades, and notices to prevent any person from accidentally consuming water or disturbing system being treated.

B. Protect against damage and discoloration caused by work of this Section.

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PART 2 - PRODUCTS

2.1 DISINFECTANT

A. Free chlorine; liquid, powder, tablet, or gas.

2.2 ALKALI

A. Caustic Soda or Soda Ash.

2.3 ACID

A. Hydrochloric type.

PART 3 - EXECUTION

3.1 EXISTING CONDITIONS

A. Prior to starting work, verify that Domestic Water System is completed, flushed and clean.

B. Prior to starting work, notify Construction Manager/General Contractor of any defects requiring correction.

C. Do not start work until conditions are satisfactory.

3.2 PREPARATION OF WATER FOR TREATMENT

A. Verify pH factor of water to be treated.

B. If pH factor is less than 7.4, introduce sufficient alkali during disinfectant injection to produce 7.4 to 7.6 pH level.

C. If pH factor is greater than 7.6, introduce sufficient acid during disinfectant injection to lower pH to 7.4 to 7.6 level.

3.3 SYSTEM TREATMENT

A. Inject disinfectant throughout system to obtain 50 to 80 ppm residual.

B. Starting at outlet closest to water sources, bleed water from each outlet until water produces odor of disinfectant. Repeat process at each outlet throughout system.

C. Test for disinfectant residual at each of the following locations:

1. Ends of piping runs.
2. Remote outlets. (Ends of each multiple fixture branch line)
2. Tanks and domestic water heaters.
3. At least 15% of outlets on each floor as directed by Architect/Engineer.

D. Maintain disinfectant in system for 24 hours.

E. If resultant disinfectant residual test is less than 25 ppm, repeat System Treatment.

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3.4 FLUSHING

A. Flush disinfectant from entire system; permit no more than residual rate of supplied incoming water.

3.5 BACTERIOLOGICAL TEST

A. Instruct Bacteriological Laboratory to take water samples no sooner than 24 hours after flushing system.

B. Take water samples at each of the following locations:

1. Where water enters system.
2. Ends of piping runs.
3. Remote outlets.
4. Tanks.
4. At least 10% of outlets on each floor other than those used for testing disinfectant residual, where directed by Architect/Engineer, but in no case less than 2 outlets per floor.

C. Analyze Water Samples in accordance with Standard Methods for the examination of Water & Waste Water, published by American Water Works Assoc., 6666 W. Quincy Ave., Denver, CO 80235.

D. If Bacteriological Test proves water quality to be unacceptable, repeat System Treatment.

3.6 PRODUCT CLEANING & REPAIRING

A. Including work of other trades, clean, repair and touch-up, or replace when directed, products which have been soiled, discolored, or damaged by work of this Section.

B. Remove debris from Project Site upon work completion or sooner, if directed.

END OF SECTION 22 14 11

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SECTION 22 14 30 - PLUMBING SPECIALTIES

PART 1 - GENERAL

1.1 WORK INCLUDED

A. Drains and drainage products.

B. Downspout nozzle.

C. Storm drain expansion joints.

D. Cleanouts.

E. Safe pans and drain flashings.

F. Sillcocks, yard hydrants, hose bibbs and hose stations.

G. Pressure gauges, thermometers, and test plugs.

H. Shock arrestors.

I. Backflow preventers.

J. Pressure reducing valves.

K. Pressure and temperature relief valves.

L. Washer and dryer wall boxes.

M. Trap chargers and accessories.

1.2 WORK FURNISHED BUT INSTALLED UNDER OTHER SECTIONS

A. Furnish electrical outlets installed in Washer Wall Box for Division 26 power wiring installation.

1.3 RELATED WORK

A. Requirements: Provide Plumbing Specialties in accordance with the Contract Documents.

B. Section 230500 - Basic Mechanical Requirements.

C. Section 230529 - Basic Mechanical Materials and Methods.

1.4 SUBMITTALS

A. Submit Product Data for the following items under provisions of the General Conditions of the Contract:

1. Floor Drains (FD)
2. Floor Sinks (FS)
3. Planter Drains (PD)
4. Deck Drains (DD)
5. Garage Drains (GD)
6. Trench Drains (TD)
7. Roof Drains (RD)
8. Controlled Flow Roof Drains (CRD)
9. Overflow Drains (OD)

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10. Downspout Nozzles (DSN)
11. Sillcocks (SC), Ground Hydrants (GH) and Yard Hydrants (YH)
12. Hose bibbs (HB) and Hose Stations (HV)
13. Pressure gauges (PG)
14. Thermometers (T)
15. Shock Arrestors (SA)
16. Backflow Preventer (BP)
17. Pressure Reducing Valve (PRV)
18. Washer Wall Box (WWB)
19. Dryer Vent Wall Box (DVWB)
20. Trap Primers (TP)

B. Submit printed Operating Instructions and Maintenance Data for the following items under provisions of Operating and Maintenance Data paragraph in Section 230500:

1. Backflow Preventer (BP)
2. Pressure Reducing Valve (PRV)

1.5 WARRANTIES

A. Provide original copies of all warranties for specific equipment where specified and in accordance with Section 230500.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

A. Where acceptable manufacturers are listed, these manufacturers must submit products that are in fact equivalent in all respects of materials, design, function, and appearance to the manufacturer listed as the base manufacturer in the specification body or drawing schedules. Deviations of any type will not be acceptable.

B. Where other acceptable manufacturers are not listed, only the base manufacturer will be accepted.

C. All items of like nomenclature shall be supplied by one manufacturer only.

2.2 FLOOR DRAINS (FD)

A. Acceptable manufacturers: Wade series 1100, JR Smith series 2005, Josam series 30000, Zurn series Z-415, Watts FD-100 series, MIFAB series F-1100.

B. Schedule:

Plan Code	FD-1	FD-1
Typical Use	Note 2	Note 2
Style	Round	Round
Material	Cast Iron	Cast Iron
Pipe Size	2” - 3”	4”
Top Size	5” min.	7” min.
Strainer	Nickel Bronze	Nickel Bronze
Vandal Proof Security Screws	Yes	Yes
Sediment Bucket	No	No
Seepage Flange	Yes	Yes
Flashing Clamp	Note 1	Note 1
Trap Primer Fitting	Where Required	Where Required
Funnel	No	No
Deep Seal (4”) Trap	Yes	Yes

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Note 1: Provide flashing clamp device for drains in areas with waterproof membrane and all drains above slab-on-grade.
Note 2: Finished areas, showers, toilets, etc.

2.3 FLOOR DRAINS, HEAVY DUTY

A. Acceptable manufacturers: Wade series 1240, JR Smith series 2330, Josam series 31200, Zurn series Z-512, Watts FD-340 series, MIFAB series F-1340C.

B. Schedule:

Plan Code	FD-2
Typical Use	Note 2
Style	Round
Material	Cast Iron
Pipe Size	2” - 8”
Top Size	12”
Strainer	Ductile Iron or Cast Iron
Vandal Proof Security Screws	No
Sediment Bucket	Yes
Seepage Flange	Yes
Flashing Clamp	Note 1
Trap Primer Fitting	Where Required
Funnel	No
Deep Seal (4”) Trap	Yes

Note 1: Provide flashing clamp device for drains in areas with waterproof membrane and all drains above slab-on-grade.
Note 2: Mechanical equipment rooms, shops, etc.

2.4 FLOOR SINKS (FS)

A. Acceptable manufacturers: Wade series 9110/9140, JR Smith series 3100/3150, Josam series 49000/49040, Zurn series Z-1900/Z-1910, Watts FD-860 series, MIFAB series FS-1520/FS-1730.

B. Schedule:

Plan Code	FS-1	FS-2	FS-3
Typical Use	Note 3	Note 4	Note 5
Style	Square	Square	Square
Size	12”x12”8”D	12”x12”x8”D	8”x8”x6”D
Material	Cast Iron	Cast Iron	Cast Iron
Finish	Enamel Interior	Enamel Interior	Enamel Interior
Grate	Note 1 Nickel Bronze	Note 1 Cast Iron	Note 1 Nickel Bronze
Dome Strainer	Yes	No	Yes
Sediment Bucket	No	Yes	No
Seepage Flange	Yes	Yes	Yes
Flashing Clamp	Note 2	Note 2	Note 2
Vandal Resistant Security Screws	Yes	No	No
Trap Primer Fitting	No	No	Yes
Funnel	No	No	No

Note 1: Provide full grate unless otherwise noted, provide 1/2 or 3/4 grate where indicated on Drawings.
Note 2: Provide flashing clamp device for drains in areas with waterproof membrane and all drains above slab-on-grade.

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Note 3: Indirect waste for kitchen, laundry, etc.
Note 4: Indirect waste and floor drainage for mechanical equipment rooms.
Note 5: Indirect waste for icemakers, sterilizers, etc.

2.5 PLANTER DRAINS (PD)

A. Acceptable manufacturers: Wade series 3220 PA, JR Smith series 2675, Josam series 39600, Zurn series Z-348, Watts FD-860 series, MIFAB series F-1820.

B. Schedule:

Plan Code	PD-1	PD-2
Typical Use	Note 1	Note 2
Style	Round	Round
Material	Cast Iron	Cast Iron
Strainer	Cast Iron Dome	Cast Iron Dome
Screen	Stainless Steel	Stainless Steel
Vandal Proof Security Screws	No	No
Flashing Clamp	Yes	Yes
Bearing Pan	No	Yes
Deck Clamp	No	Yes
Perforated Gravel Stop	No	No

Note 1: Slab on grade planters.
Note 2: Planters above slab on grade.

2.6 DECK DRAINS

A. Acceptable manufacturers: Wade series 3100, JR Smith series 1410, Josam series 23000, Zurn series Z-150, Watts RD-100-CP series, MIFAB series R-1200.

B. Schedule:

Plan Code	DD-1	DD-1	DD-2
Style	Square	Square	Square
Material	Cast Iron	Cast Iron	Cast Iron
Pipe Size	2”-6”	8”	2”-6”
Top Size	12”x12” min.	14”x14” min.	12”x12” min.
Grate	Nickel Bronze	Nickel Bronze	Ductile Iron
Vandal Proof Security Screws	Yes	Yes	Yes
Flashing Clamp	Yes	Yes	Yes
Deck Clamp	Yes	Yes	Yes
Bearing Pan	Yes	Yes	Yes
Extension	Adjustable	Match Insulation	Adjustable

2.7 TRENCH DRAINS, MEDIUM DUTY

A. Acceptable manufacturers: Wade series 2950, JR Smith series 2850, Josam series 76000, Zurn series Z-667, Watts TD-940 series, MIFAB series T-1320.

B. Schedule: See plans

Note 1: Provide length as indicated on drawings.

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2.8 TRENCH DRAINS, FRAME AND GRATE

A. Acceptable manufacturers: Wade series 2902/2908, JR Smith series 2970/2940/2910, Josam series 76700/76500/76300, Zurn series Z-793/Z-792/Z-784, Watts TD-920 series, MIFAB series T-1200/T-1150.

B. Schedule: See plans

Note 1: Provide length as indicated on drawings.

2.9 ROOF DRAINS

A. Acceptable manufacturers: Wade series 3000/3200, JR Smith series 1010/1330, Josam series 21500/22080, Zurn series Z-100/Z-125, Watts RD-300/200 series, MIFAB series R-1200.

B. Schedule: See plans

2.10 OVERFLOW DRAIN

A. Acceptable manufacturers: Wade series 3000/3200, JR Smith series 1010/1330, Josam series 21500/22080, Zurn series Z-100/Z-125, Watts RD-300/200 series, MIFAB series R-1200-R.

B. Schedule: See plans

Note 1: Provide overflow drains with 2" high stand pipe or dam as appropriate for the style of drain furnished.

2.11 DOWNSPOUT NOZZLES

A. Acceptable manufacturers: Wade series 3940, JR Smith series 1770, Josam series 25010, Zurn series Z-199, Watts RD-940 series, MIFAB series R-1940.

B. Schedule: See plans

2.12 EXPANSION JOINTS

A. Acceptable manufacturers: Wade series 3900, JR Smith series 1710, Josam series 26200, Zurn series Z-190, Watts RD-900 series, Metraflex, MIFAB series R-1900, Hyspan.

B. Provide as required, coordinate with structural.

2.13 FLOOR CLEANOUTS

A. Acceptable manufacturers: Wade series 6000, JR Smith series 4020/4100/4200, Josam series 56000, Zurn series Z-1400, Watts CO-200-R/200-RX/200-US series, MIFAB series C1100-R/C1100-XR/C1100-UR.

B. Cast iron adjustable body, ABS plug, vandal-proof security screws.

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1. Provide flange and flashing clamp for Cleanouts in areas with waterproof membrane and all cleanouts above slab-on-grade.

2. Provide nickel bronze top to match floor finish as indicated in the Architectural finish schedule. Provide heavy duty nickel bronze top for cleanouts in storage rooms, kitchens, and similar areas. Provide heavy duty cast iron or ductile iron top for cleanouts in equipment rooms, traffic areas, parking areas, and similar unfinished areas.

2.14 WALL CLEANOUTS

A. Acceptable manufacturers: Wade series 8560 with 8480R, JR Smith series 4530, Josam series 58790, Zurn series 1446, Watts CO-460-RD series, MIFAB series C-1460.

B. Cast iron clean out tee, ABS plug, vandal proof security screws, stainless steel cover with screw.

2.15 GRADE CLEANOUTS

A. Acceptable manufacturers: Wade series 8300 MF with 6000 spigot outlet, JR Smith series 4250, Josam series 58850, Zurn series Z-1474 with Z-1449, Watts CO-300 series, MIFAB series C-1300.

B. Heavy duty cast iron clean out housing, heavy duty cast iron or ductile iron cover, cast iron ferrule, ABS plug, vandal proof security screws.

1. Provide piping system identification cast into cover; "SAN" for sanitary waste cleanouts, "STORM" for storm drainage cleanouts.

2.16 VENT CAPS

A. Acceptable manufacturers: JR Smith series 1748, Josam series 26700, Zurn series Z-193, Watts RD-680 series, MIFAB series R-1930.

B. Cast iron body and dome, vandal proof screws.

2.17 SAFE PANS AND DRAIN FLASHINGS

A. Provide one of following systems:

1. #24 B&S gauge (0.021") minimum sheet copper with l5 lb. asphaltic felt sub pan (underliner).
2. 0.040" non-plasticized chlorinated polyethylene sheet with 30 lb. felt underliner.
3. 3 ply 15 mil polyvinylchloride sheet with 30 lb. felt underliner.

2.18 WATER HEATER SAFETY PAN (WHSP)

A. Provide Shamrock Industries Inc. or equivalent gray polyethylene pan 2" larger than heater on all sides and minimum 1-1/2” deep with side or bottom drain fitting on electric water heaters installed above ceilings, under counters or on wood flooring.

B. Provide Ruud Mfg. Co. "Heater Pan", Canplas or equivalent spun aluminum pan 2” larger than heater on all sides and minimum 1-1/2” deep with side or bottom drain fitting on gas fired water heaters installed on combustible foundations with 3/4" thick fire proof liner between pan and combustible construction.

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2.19 SILLCOCK, EXPOSED, NON-FREEZE

A. Acceptable manufacturers: Woodford series 65, JR Smith series 5609, Josam series 71050, Zurn series Z-1310, Wade series 8600, Watts HY-420 series.

B. Schedule: See plans.

2.20 SILLCOCK, EXPOSED, MILD CLIMATE

A. Acceptable manufacturers: Woodford series 74, JR Smith series 5607, Josam series 71220, Zurn series Z-1333, Watts HY-430 series.

B. Schedule: See Plans.

2.21 SILLCOCK, MIXING, NON-FREEZE

A. Acceptable manufacturers: Woodford series HC65.

B. Schedule: See Plans.

2.22 SILLCOCK, WALL BOX, NON-FREEZE

A. Acceptable manufacturers: Woodford series B65, JR Smith series 5509, Josam series 71150, Zurn series Z-1300, Wade series 8600,175, Watts HY-725 series.

B. Schedule: See Plans.

2.23 SILLCOCK, WALL BOX, MILD CLIMATE

A. Acceptable manufacturers: Woodford series B74, JR Smith series 5709, Josam series 71170, Zurn series Z-1330, Wade series 8600MT, Watts HY-330 series.

B. Schedule: See Plans.

2.24 SILLCOCK, WALL BOX, MIXING

A. Acceptable manufacturers: Woodford series HCB65, JR Smith series 5560, Josam series 71650, Zurn series Z-1325, Wade series 8606HC, Watts HY-700 series.

B. Schedule: See Plans.

2.25 GROUND HYDRANTS

A. Acceptable Manufacturers: Woodford Series Y95, Wade Series 8602, JR Smith Series 5810, Watts HY-500 series, Zurn.

B. Schedule: See Plans

2.26 POST HYDRANTS

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A. Acceptable manufacturers: Wade series 8610, JR Smith series 5910, Zurn series Z-1385, Woodford series IOWA, Watts HY0600 series.

B. Schedule: See Plans.

2.27 HOSE BIBBS

A. Acceptable manufacturers: As listed in schedule.

B. Schedule:

Plan Code	HB-1
Typical use	Note 1
Material	Brass
Finish	Polished Chrome
Vacuum Breaker	Yes
Outlet	3/4" Hose Thread
Operator	Loose Key
Wall Flange	Yes
Chicago Faucet	No. 952
Woodford	-----
T & S Brass	B-720

Note 1: Toilet rooms, Janitor's mop station, etc.
Note 2: Finished areas.
Note 3: Equipment rooms, unfinished areas.
Note 4: Install separate hose bid at mop sink in janitors closet for chemical mixing.

2.28 STATIONARY PRESSURE GAUGES

A. Acceptable manufacturers: Trerice 600C Series, Weksler Regal Series, Weiss Instruments.

B. Schedule:

Type	4-1/2” Dial
Bourbon Tube/Socket	Stainless Steel Tube 316 Stainless Steel Socket
Accuracy	ANSI B40.1 Grade 1A 1% F.S. over middle half of range
Case	Cast Aluminum
Window	Clear Glass
Snubber	Yes
Coil Syphon	For Steam Service
Gauge Cock	Yes
Set Hand	No
Silicone Filled	No
Weatherproof	No

C. Range: Select gauges for the following standard ranges unless otherwise indicated on drawings, or as required for special systems.

1. Domestic Water 0 to +160 psi

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2. Pump Gauges -30 in Hg to +100 psi

2.29 STATIONARY THERMOMETERS

A. Acceptable manufacturers: Trerice Industrial Series, Ametek Industrial Series, Weiss Instruments, Miljoco, Weksler.

B. Schedule:

Type	Adjustable angle
Case	9" cast aluminum
Window	Clear acrylic
Tube	Lens front, magnifying
Stem	Aluminum, insertable
Separable Socket	Brass
Fill Type	Spirit: Blue colored, organic

C. Range: Select thermometers, for the following standard ranges unless otherwise indicated on Drawings, or as required for special systems.

1. Domestic cold water 0 to 100 °F
2. Domestic hot water 30 to 240 °F

2.30 TEMPERATURE AND PRESSURE TEST PLUGS (T&PTP)

A. Manufacturer: Trerice, Fairfax, Flow Design, Peterson Equipment, Weksler.

B. Plugs suitable for vacuum to 600 psig and temperatures of -20 deg.F to 300 deg.F with cap and extension for insulated pipe where required.

C. Provide one pressure gauge, gauge adapter, and two thermometers in shock-proof case.

D. Schedule:

PLAN CODE:	MAKE:	MODEL:	PRESSURE & TEMPERATURE TEST KIT
T&PTP	Trerice	D3741	Trerice D3752 (0-300 psig)

2.31 SHOCK ARRESTORS FOR WATER (SA)

A. Manufacturer: Precision Plumbing Products Co., Wade Shokstop, J.R. Smith series 5000, Josam series 75000, Zurn Z-1700, Watts SS series.

B. Schedule:

"P.D.I." SIZE	FIXTURE UNITS
A	1-11
B	12-32
C	33-60
D	61-113

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E	114-154
F	155-330

2.32 REDUCED PRESSURE BACKFLOW PREVENTER

A. Acceptable manufacturers: Conbraco Series 40-200, Watts series 009 and 909, Febco series 825Y, Hersey series FRP-II.

B. Bronze body, independent spring loaded check valves, diaphragm type differential pressure relief valve, shut-off ball valves, strainer, test cocks. Suitable for water temperature range of 33-140 °F.

C. Approved under ASSE 1013 and AWWA C511.

D. Backflow preventer test kit: Provide complete test kit including pressure gauge, test valves, high pressure hoses, adaptor fittings, mounting strap, and instructions, in a corrosion resistant carrying case.

2.33 PRESSURE REDUCING VALVE (PRV)

A. Acceptable manufacturers: Watts series N223B, Conbraco, Hoffman.

B. 300 psi bronze body, replaceable seat, strainer, adjustable outlet pressure, thermal expansion by-pass. Suitable for water temperature up to 160 °F.

C. Approved under ASSE 1003 and IAPMO.

2.34 TEMPERATURE AND PRESSURE RELIEF VALVES (T&P)

A. Acceptable Manufacturers: Kunkle, Watts, Conbraco, McDonnell and Miller.

B. Schedule: See drawings.

2.35 AUTOMATIC CLOTHES WASHER SUPPLY AND DRAIN BOX (WWB)

A. Acceptable Manufacturers: Guy Gray, Symmons, Watts Regulator.

B. Schedule: See drawings

2.36 DRYER VENT WALL BOX (DVWB)

A. Manufacturer: Guy Gray.

B. Schedule:

PLAN CODE	MAKE	MODEL
DVWB	Guy Gray	CV-4M
Furnish units less electrical outlets and less door.		

2.37 TRAP CHARGERS AND ACCESSORIES (NO PLAN CODE)

A. Manufacturer: Precision Plumbing Products, Co. ("P.P.P.")

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B. Pressure Activated Trap Primers:

1. Schedule:

MODEL	DISTRIBUTION UNIT	SUPPLY TUBE
P-1	1 thru 4 outlets per unit as shown on drawings.	Single

C. Electronic Trap Primers:

1. Electric solenoid valve actuated with integral electronic timer with manual override switch, water inlet, water supply isolation valve, atmospheric vacuum breaker, water hammer arrestor, calibrated manifold for equal quarter distribution; all housed in steel box with cover for surface mounting or recessed mounting in wall.
2. Schedule:

MODEL	DISTRIBUTION UNIT
Auto Prime 500	1 thru 4 outlets per unit as shown on drawings.
Prime Time PT/PTS	4 thru 30 outlets per unit as shown on drawings.

D. Barrier Type Floor Drain Trap Seal:

1. Meet ASSE Standard 1072.
2. Approved Manufacturers: Sure-Seal Manufacturing or approved equal.

PART 3 - EXECUTION

3.1 DRAINS

A. Coordinate drain placement with Contractor for Division 3 - Concrete.

B. Drain, strainer, and grate finishes shall be as specified, cover all finished surfaces during construction to prevent damage.

C. Install drains with "P" pattern traps and vents as required.

D. All drain bodies shall be plugged during construction to prevent foreign objects, dirt, concrete, etc. from entering the drain and drainage piping.

E. Planter drains shall not receive domes until final landscaping is accomplished. Provide closure plugs until landscaping and dome installation is furnished.

F. Drains shall be set flush and level with finished surfaces, with grate pattern parallel or perpendicular to adjacent walls or floor patterns.

G. Flash all drains on roofs, upper floors, and floor over crawl spaces with 24"x24" minimum flashing pans. Shower pans shall be turned up in walls to a minimum of 6" above the shower receptor threshold.

H. Clean and polish all drain bowls, rims, strainers, and grates prior to final inspection.

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3.2 CLEANOUTS

A. Provide cleanouts in waste, soil, and storm piping at each change in direction greater than 45°, as required by Jurisdictional Code.

B. Provide cleanouts at 50 feet on center for all interior sanitary and storm piping, and at each base of waste, soil or storm pipe stack or drop, 100 feet on center for all exterior sanitary and storm piping or as required by jurisdictional code.

C. Provide appropriate access tops for imposed construction.

D. Coordinate interior floor cleanout locations with contractor for Division 3 - Concrete.

E. Cleanouts to be provided with ABS or Delrin plugs. Lead sealed, brass, or cast iron plugs will not be acceptable unless specifically required by jurisdictional code authority.

F. Provide 24"x24" minimum flashing pans and clamp devices for all cleanouts located on upper floors or floors over crawl spaces.

G. Where cleanout arms extend horizontally and/or vertically more than 15 feet from the sewer main which they are serving, provide 2" minimum vent off the end of the arm and connect to the building vent system.

H. Clean and polish all cleanout access covers prior to final inspection.

I. Cleanout access covers shall be flush and level with finished building surfaces.

J. Install cleanout plugs on exposed or accessible piping. Plugs shall be line size up to 3" and over 8", 4" plugs for sizes 4" thru 8".

K. Provide wall cleanouts where piping is concealed in walls or non-accessible chases, use tapped cleanout tee or tapped extension to within 4" of wall face. Do not use no-hub type blind plugs for wall cleanouts.

L. Provide 12"x12"x8" thick 3000 lb. concrete pads for all grade cleanouts. Concrete shall be in accordance with Division 3 - Concrete. Tops of pads to be 1" above finish grade and cleanout access flush and level and centered in pad surface.

3.3 DOWNSPOUT NOZZLES (DSN)

A. Terminate storm and overflow drains into full size nickel bronze downspout nozzles, seal annular space between wall opening and pipe with silicone seal, anchor nozzle wall flange with three 1/4" flat head machine bolts and lead expanders. Set DSN a minimum of 6" and a maximum of 12" above the splash block surface, unless otherwise noted.

B. Install drain pipe to thread adaptors and threaded galvanized schedule 40 nipples or short pipe through exterior wall for threading on the DSN. T.O.E. nipples or short pipe may be used for "NO-HUB" system where galvanized and drain pipe are joined by an approved No Hub coupling adaptor. Anchor pipe to building immediately downstream of adaptor.

C. Coordinate required location of standard splash blocks at all DSN locations for Construction Manager/General Contractor.

3.4 STORM DRAIN EXPANSION JOINTS (EJ)

A. Install vertical expansion joints at the roof drain outlet for all drains having straight vertical run directly from the drain of 10 feet or more.

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B. Install special horizontal expansion joints at center of runs for horizontal storm piping having one hundred feet of straight run. Anchor ends of run. Provide expansion joints where storm drains cross a building expansion joint. Anchor both sides of building joint or provide adequate swing joints with appropriate anchors.

3.5 SANITARY VENT CAPS

A. Install where shown on drawings, vandal resistant vent caps a minimum of 14" above the roof surface.

B. Provide 24"x24"x4 lb. sheet lead flashing up 12" above roof to vent flashing collar.

C. Secure dome and entire assembly tight to pipe.

3.6 SAFE PANS AND DRAIN FLASHINGS (no plan code)

A. Provide safe pans for all shower bases, shower rooms, wet rooms and kitchen areas. Pans shall extend wall to wall and turn up at least 6" above finish floor level or receptor rims into wall construction. Pans shall be laid over non-puncturing base such as heavy asphaltic felt, fine sand that bears no silica, or other acceptable material.

B. All drains on upper floors or over crawl spaces shall be flashed with flashing extending a minimum of 12" beyond the drain top dimensions.

C. Seams to be folded and shaped as required:

1. Solder lead seams.
2. Solder sheet copper seams with 50/50 (50% tin, 50% lead) or 45/55 (45% tin, 55% lead) commercial grade solder.
3. Solvent weld PVC and un-plasticized chlorinated polyethylene seams.

3.7 WATER HEATER SAFETY PAN (WHSP)

A. Install safety pans for all electric water heaters installed above ceilings, under counters or on wood flooring. Route drain to floor sink/drain with indirect connection.

B. Install safety pans for all gas fired water heaters installed on combustible foundations or where leakage will cause damage. Route drain to floor sink/drain with indirect connection.

C. Provide structural supports, air gapped pan drains, drain extensions and pan drain connections as required.

3.8 SILLCOCKS (SC)

A. Provide sillcocks at 100 feet maximum spacing around building perimeter, and at other locations shown on Drawings.

B. Provide all sillcocks with accessible stop and drain valves in heated areas, provide access panels where required.

C. Provide flush or surface mounting, square and plumb to building walls, with supply tube pitched for complete drainout.

D. Anchor all sillcocks with anchor flange provided by manufacturer.

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E. Caulk annular space between walls and sillcock and sillcock piping with non-hardening silicone base sealant.

F. Mount sillcocks at 24" above finished grade or surfacing.

G. Where mounting heights other than 24" are shown on the Drawings, the Drawings shall supercede the Specifications.

H. Vacuum breakers to be non-removable.

I. Clean all surfaces including faceplate, box, access door, cam lock and interior of box prior to final inspection.

J. Sillcocks shall not be operated by hand tools, provide 2 keys per sillcock. Units found to be marred due to hand tool operation or other causes, shall be replaced at no increase to the Contract Sum.

K. Clean and polish entire sillcock prior to final inspection.

3.9 GROUND HYDRANTS (GH)

A. Provide ground hydrants with vacuum breaker installed true and plumb, of lengths required to prevent freezing. Bury depth to be 6" deeper than maximum local soil frost penetration, 48" minimum.

B. Provide drainage means as detailed on drawings, do not obstruct drainage orifice.

C. Provide drywells and drain tube extensions as required.

D. Provide 12"x12"8" concrete support and anchor pads. Top of pad set at 1" above finished grade level, or flush with paved surfaces as appropriate.

E. Provide gasketed lid for all box type hydrants, waterproof.

F. Provide protection from wheel or physical damage during construction.

G. Hydrants shall not be operated by hand tools, provide 2 keys per hydrant. Units found to be marred due to hand tool operation or other causes will be replaced at contractors expense.

H. Clean and polish entire hydrant assembly prior to final inspection.

3.10 HOSE BIBBS (HB)

A. Provide hose bibbs in each equipment room, toilet room and kitchen area equipped with floor drainage systems and where shown on drawings, maximum spacing shall accommodate 50 feet of hose to any point within the drainage area measured around obstructions and equipment, in lieu of straight line measurement. Hose bibbs in toilet rooms mounted under standard lavatory, do not install near ADA lavatory where it could impede access.

B. Anchor hose bibb within wall for rigid flush flange mounting.

C. Install bibb true and plumb with wall flange flush to surface, caulk annular space between wall and flange.

D. Mounting height to be 18" above floor in toilet rooms and immediately under furthest lavatory from entry, 60" above floor in equipment rooms or as shown on drawings.

E. Hose bibbs shall not be operated with hand tools, use only tee handle, furnish one tee handle per bibb. Units found marred due to hand tool operation or other causes will be replaced at Contractors expense.

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F. Clean and polish hose bibbs prior to final inspection.

3.11 MIXING UNIT AND HOSE STATION (HV)

A. Anchor stations with 3/8" mounting bolts and expanders or toggles as appropriate.

B. Install stations true and plumb, complete with hose rack.

C. Mounting height shall be 60" above finished floor unless otherwise specified on drawings.

D. Mount hose and nozzle to station and clean entire unit prior to final inspection.

3.12 STATIONARY PRESSURE GAUGES (PG)

A. Provide gauges for steam, water, air and vacuum systems, complete with gauge cocks and snubbers, where required by Drawings.

B. Install in semi or upright position, tilted so as to be readable from floor level.

C. Clean gauge, and glass, and calibrate by test prior to final inspection.

3.13 STATIONARY THERMOMETERS (T)

A. Install thermometers where indicated on Drawings in upright position with case tilted to be readable from floor level.

B. Clean case and glass prior to final inspection.

3.14 TEMPERATURE AND PRESSURE PLUGS (T&PTP)

A. Provide plugs where periodic temperature and/or pressure indication is required as shown on drawings. Provide 1/4" MPT tapping, cap and seal for plug and extension for insulated pipe as applicable.

3.15 SHOCK ARRESTORS FOR WATER (SA)

A. Provide shock arrestors in accordance with Plumbing Drainage Institute (PDI) Standard WH-201 and as shown on drawings.

B. Provide 8"x8" minimum access panels centered on each shock arrestor that is otherwise inaccessible.

C. Shock arrestors shall be mounted as close to the line or quick closing valve as possible. Remote mounting or excessive (over 6") nipple mounting will not be acceptable.

D. Provide ball valve at each shock arrestor to allow units to be easily removed/replaced.

E. Each shock absorber piston shall be exercised at least once prior to final installation. (Physically move the piston up into chamber from throat of unit. Use wooden push rod only in the performance of this exercise.)

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3.16 REDUCED PRESSURE BACKFLOW PREVENTER (BP)

A. Provide reduced pressure type backflow preventers on all connections between the domestic water system and make-up supplies to any non potable system, i.e.: Heating, Boilers, Cooling Towers, Chiller, Evaporative Coolers, and the like.

B. Anchor backflow preventer in place.

C. Clean and test assembly in place in accordance with State Health Code.

D. Provide funnels and attach to unit per manufacturers instructions, in true, level and plumb position.

E. Provide IPS to solder adaptor to funnel outlet and run type M copper tubing in an unobtrusive manner routed to an approved drain receptor.

F. Hang and anchor drain tubing so as to be rigid and stable.

G. Permanently affix drain outlet at drain receptor so as to be rigid and unmovable.

3.17 PRESSURE REDUCING VALVE (PRV)

A. Provide unistrut or similar frame for mounting all components of the pressure reducing valve station.

B. Arrangement shall be as shown on Drawings including by-pass.

C. Provide drain valves both sides of station on headers on low points.

D. Provide unions, strainer, valves, petcocks, gauges, straps and other accessories as detailed on Drawings.

E. Set each pressure reducing valve using full system pressure and flow individually to outlet pressures specified.

F. All gauges shall be installed to be readable from floor level. Provide petcocks on each gauge connection.

3.18 TEMPERATURE AND PRESSURE RELIEF VALVES (T & P)

A. Provide temperature and pressure relief valves, with full size drains extended and air gapped to floor drains or approved receptor. Provide relief valves on all water heaters, pressure vessels and closed piping systems.

3.19 TRAP CHARGERS AND ACCESSORIES

A. Provide trap primer valve, gooseneck connection, distribution boxes, distribution tubing, air gap or vacuum breaker, extension drains, and pattern traps with charger connections for all emergency floor drains.

B. Support and brace charger, distribution boxes, piping and connections as appropriate.

3.20 WASHER WALL BOXES (WWB) AND DRYER WALL BOX (DVWB)

A. Set level and plumb and at height required by furnished appliances.

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B. Coordinate with Appliance Supplier.

C. Provide water, waste, and vents as required.

D. Provide shock arrestors on hot and cold supplies to box as close to box connections as possible - provide 8"x8" access panel to each shock arrestor.

END OF SECTION 22 14 30

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Louisa May Alcott
Community School

SECTION 22 44 40 - PLUMBING FIXTURES

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Plumbing Fixtures and Trim.

B. Plumbing Fixture Accessories.

1.2 PRODUCTS INSTALLED BUT FURNISHED UNDER OTHER SECTIONS

A. Section 115313 - Laboratory Equipment: Laboratory fixtures, trim and equipment.

B. Section 114000 - Food Service Equipment: Kitchen fixtures, trim and equipment.

1.3 RELATED REQUIREMENTS

A. The General Conditions, Supplementary Conditions and Division 1, General Requirements apply to this section and Contractor shall review and adhere to all requirements of these documents.

B. Section 230500 - Basic Mechanical Requirements.

1.4 RELATED SECTIONS

A. Section 221410 - Plumbing Piping.

B. Section 221430 - Plumbing Specialties.

C. Section 224450– Plumbing Equipment.

D. Section 224460 - Special Plumbing Equipment Systems.

E. Section 230529 - Basic Mechanical Materials and Methods.

1.5 REFERENCES

A. Comply with the applicable provisions and recommendations of the following:

1. ANSI A112.19.1 - Enameled Cast Iron Plumbing Fixtures.
2. ANSI A112.19.2 - Vitreous China Plumbing Fixtures.
3. ANSI A112.19.3 - Stainless Steel Plumbing Fixtures.

1.6 SYSTEM DESCRIPTION

A. Provide all plumbing fixtures, materials, labor, accurate rough-in setting, leveling and adjustments of all fixtures, trim and specialties.

1.7 QUALITY ASSURANCE

A. Qualification:

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1. Provide fixtures trim and specialties in accordance with style, type, quality and function as established by the named manufacturer and model specified for each item.
2. Provide all installations in accordance with jurisdictional code and health authorities standards, restrictions and recommendations.
3. Provide all fixtures and trim using a single manufacturer where possible, deviation will be allowed only where specifications indicate otherwise.

1.8 SUBMITTALS

A. Submit Product Data for the following items under provisions of the General Conditions of the Contract:

1. Fixtures
2. Carriers
3. P-Traps
4. Disposers
5. Faucets, showerheads, valves, cocks, supplies and stops.
6. Finishes, material and colors.
7. Fixture specialties

B. Submit printed Operating Instructions and Maintenance Data for the following items under provisions of Operating and Maintenance Data paragraph in Section 230500:

1. Flush Valves and Faucets.
2. Disposers

1.9 WARRANTIES

A. Provide original copies of all warranties and extended warranties for specific equipment where specified and in accordance with Section 230500.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

A. Cast iron and vitreous china: Kohler - Eljer - American Standard – Crane - Zurn – Toto - Mansfield.

B. Stainless steel sink 316 18 gauge minimum: Elkay - Just - Haws - Kohler.

C. Molded Stone: Fiat - Florestone - Stern Williams - E.L. Mustee.

D. Terrazzo: Fiat - Florestone - Stern Williams - Bradley.

E. Fiberglass and Plastic: Kohler - Snyder - Owens Corning - Bradley - Aquarius - Fiat - E.L. Mustee - Fiberglass Systems - Lasco Hitech - FLorestone - Sterling.

F. Dual Flush Water Closet Flush Valves: Sloan – Zurn - Mansfield.

G. Low Flow Urinals: Sloan – Zurn – Toto – Kohler - Mansfield.

H. Waterless Urinal: Falcon – Sloan – Zurn.

I. Electric Water Coolers: Elkay - Halsey Taylor - Cordley - Haws - Sunroc - Filtrine - Oasis - Acorn.

J. Specialty Drinking Fountains: Western - Haws - Filtrine - Halsey Taylor - Elkay - Oasis - Acorn.

K. Emergency Showers and Eye Wash Equipment: Haws – Western - Speakman - Water Saver Co. - Chicago Faucet - T & S Brass - Bradley - Guardian - Encon.

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L. Laboratory Faucets and Cocks: Chicago Faucet - Water Saver Co. - T & S Brass - Royal Brass - Speakman – Zurn - Delta.

M. Water Mixing Valves Thermostatic, or Pressure Balanced: Leonard - Symmons - Kohler - Powers - Lawler – Bradley – Watts – Amstrong International - Delta.

N. Metering Faucets: Bradley - Symmons – Speakman - Zurn – Moen - Delta.

O. Flush Valves: Sloan Royal - Delany Flushboy – Zurn - Aquaflush – Toto – Moen (hands free) - Speakman.

1. All flush valves require 'dirt grabber' flush valve filter field installed. See paragraph 2.23 in this section.

P. Toilet Seats: Comfort Seats – Bemis - Beneke - Sperzel - Church.

Q. Garbage Disposers: Waste King - Insinkerator - Big Genie.

R. Traps, Stops, Supplies, Airgaps, Drains: Kohler - Eljer - American Standard - Bridgeport - Brasscraft - Dearborn - Sayco - Frost - Eastman - McGuire – Zurn - Delta.

S. Chair Carriers: Josam - J.R. Smith - Zurn - Wade – Mifab - Watts.

T. Faucets: Kohler - Eljer - American Standard - Bradley - Valley - Elkay - Chicago - Delta - Moen - Symmons - Speakman - T&S Brass – Zurn - Watts.

U. Solar Powered Faucets and Flush Valves: Sloan – Zurn.

V. Sensor Faucets: Sloan – Zurn – Toto - Moen - Speakman - Bradley - T&S Brass – Delta – Chicago Faucets - Symmons.

W. Kitchen Equipment Trim: Fisher - Chicago Faucet - T & S Brass - Delta.

X. Wash Fountains & Showers: Bradley - Willoughby - Intersan.

2.2 WATER CLOSETS

A. Floor Set, Siphon Jet, Valve Operated, Water Saver, 12" rough with open front seat:

B. Wall Hung, Siphon Jet, Valve Operated, Water Saver, 5" rough with open front seat:

2.3 LAVATORIES

A. Wall Hung, Vitreous China, Carrier Mounted: See drawings.

B. Counter Top Mounted Oval: See drawings.

C. Counter Top Mounted Round: See drawings.

2.4 LOW FLOW URINALS

A. Wall mounted, flush valve: See drawings.

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2.5 SERVICE SINKS

A. Enameled Cast Iron: See drawings.

Plan Code:	SS-1
Make:	Kohler
Style:	Trap Standard
Model:	K-6718
Faucet:	K-6673
Guard:	K-8936
Material:	Enameled Cast Iron

2.6 ELECTRIC WATER COOLERS

A. Wall Hung, Carrier Mounted, Two Level: See drawings.

2.7 SINKS

A. Stainless Steel, Self Rim: See drawings.

2.8 GARBAGE DISPOSAL UNITS

A. Continuous Feed Type w/Overload Protection:

Plan Code:	GDU-1	GDU-2
Make:	Insinkerator	Insinkerator
Model:	17	555 SS
Warranty Parts:	5 years	5 years
Warranty Labor:	1 year	1 year
Motor HP:	¾	¾
Voltage:	120	120
RPM:	1725	1725
Trap: (Kohler)	K-9004-2”	K-9004-2”

2.9 SHOWERS

A. Individual Concealed Pressure Balancing Valve and Head. (Stall provided under Architectural Divisions of the Work.)

Plan Code	SH-
Type:	Metering
Make:	Symmons
Mixing Valve:	4-500-VTX
Metering Valve:	V-428
Head:	4-121-3
Arm:	301

B. MASTER THERMOSTATIC MIXING VALVES

C. Cabinet Mounted and Exposed Type Master Mixing Valves:

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2.10 MASTER THERMOSTATIC MIXING VALVES

A. Cabinet mounted and exposed type master mixing valves: adjustable setpoint, thermostatic type, adjustable limit stops, ball valve shut-offs, inlet checkstops, outlet thermometer. Provide recessed locking stainless steel cabinet where indicated.

B. Provide valves of sizes and capacities scheduled on Drawings. Provide high-low manifold type where specified and where required to meet specified range of flow.

C. Leonard Type TM, Symmons Series 5, Bradley.

2.11 LAVATORY THERMOSTATIC MIXING VALVES

A. Adjustable high temperature limit stop (factory set for 110°F), thermostatic type, inlet checkstops. Provide recessed locking stainless steel cabinet where indicated.

B. Provide valves of sizes and capacities scheduled on Drawings.

C. Models:

1. Exposed: Leonard 210-SB, Symmons Series 5.
2. S.S. Cabinet: Leonard TA-254-STSTL, Symmons Series 5B., Bradley.

2.12 FIXTURE SUPPLIES & STOPS

A. Schedule:

Sink & Lavatory Supplies:		(1/4 turn chrome ball valve, stainless steel braided tube, 1/2” x 3/8”) (L.K. Stops, 12" Riser, 1/2 x 3/8)			
Make:	Brass Craft	Bridgeport	Frost	Dearborn	Watts
Model:	SCR 1912	1694 LK	7824-2LK	2712 KCW	BV8940LK
DF & Lavatory Supplies:		(W.H. Stops, 12" Riser, 1/2" x 3/8")			
Make:	Brass Craft	Bridgeport	Frost	Dearborn	Watts
Model:	CR 1912	1694	7824-2	2712 SCW	BV8940LK
Bidet & Sink Supplies:		(L.K. Stop, 20" Riser, 1/2" x 1/2")			
Make:	Brass Craft	Bridgeport	Frost	Dearborn	Watts
Model:	SCR 3920	1666 or 1786	8135-2/8218-2	None	BV8940LK
Bidet & Sink Supplies:		(W.H. Stop, 20" Riser, 1/2" x 1/2")			
Make:	Brass Craft	Bridgeport	Frost	Dearborn	Watts
Model:	CR 3920A	1695 MOD	7816-2	None	BV8940LK
Water Closet Tank Supplies:		(L.K.) Stop. 12" Riser, 1/2 x 3/8)			
Make:	Brass Craft	Bridgeport	Frost	Dearborn	Watts
Model:	SCR 1912 DL	1770 LK	7925-2LK	3112 KCW	BV8940LK
Water Closet Tank Supplies:		(W.H. Stop, 12" Riser, 1/2 x 3/8)			
Make:	Brass Craft	Bridgeport	Frost	Dearborn	Watts
Model:	CR 1912 DL	1170	7925-2	3112 SCW	BV8940LK

2.13 FLUSH VALVE FILTER ‘DIRT GRABBER’

A. ‘Dirt Grabber’ Flush Valve Filter #SFDG1, South Fork Manufacturing Telephone (801) 953-3001.

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PART 3 - EXECUTION

3.1 INSPECTION

A. Examination: Examine the contract documents and provide all necessary attachments, accessories, support equipment and materials as necessary to fit allocated spaces.

3.2 PREPARATION

A. Field Measurements: Verify all dimensions and installation requirements so that work can be accurately fitted to other construction and in accordance with the intent of the contract documents. Be responsible for accuracy of measurements and adequate space requirements for the precise fitting and assembly of finished work.

3.3 INSTALLATION/APPLICATION/PERFORMANCE/ERECTION

A. Water Closets:

1. Wall Mounted

   a. Closet carriers are to be rigidly anchored to the floor structure in accordance with manufactures installation instructions.
   b. Wall mounted water closets will be rigidly supported with brass mounting studs on a concealed metal carrier. Transmitting fixture weight loads to the fixture pipe connection or wall framing will not be acceptable.
   c. Water closets and trim shall be set level and plumb.
   d. Spacing of water closets shall be in accordance with contract documents and jurisdictional codes.
   e. Flush valve serving water closets located within the handicap stalls shall be installed with the flush handle to the “open side” of the toilet stall (opposite of the grab bar side).

2. Floor Mounted

   a. Floor mounted water closet flanges are to be solidly anchored to the floor with lag screws, or bolts and expanders as appropriate for floor construction.
   b. Water closet bowls are to be rigidly anchored to the floor flanges.
   c. Provide fixture bolt caps to match fixture color for all exposed fixture bolts and nuts.
   d. Water closets and trim shall be set level and plumb. Insert copper shims under base of bowl if required to level unit.
   e. Spacing of water closets shall be in accordance with contract documents and jurisdictional codes.
   f. Flush valve serving water closets located within the handicap stalls shall be installed with the flush handle to the “open side” of the toilet stall (opposite of the grab bar side).

3. Water Closet Supplies

   a. Supplies shall be roughed with "L" copper tube nipple through wall cut to exact length and finished with escutcheon, matching fixture trim finish.

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4. Water Closet Seats

   a. Secure seats to water closets and adjust self-sustaining check hinge to hold the seat at any raised position. Removable bumpers shall match seat color and be secured.

B. Lavatories:

1. Wall and Counter Mounted

   a. Wall mounted lavatory carriers are to be rigidly anchored to the floor structure in accordance with manufacturers installation instructions.
   b. Carriers are to be furnished with a metal mounting plate and bearing plate or concealed arm carriers.
   c. Wall mounted lavatories are to be supported by concealed metal carriers. Transmitting fixture weight loads to the fixture pipe connection <u>is not acceptable</u>.
   d. Wood or metal mounting plates anchored to the wall framing or studs will not be acceptable.
   e. Carriers are to become part of the structure and the lavatories shall not exert any weight or stress on the interior wall.
   f. Lavatories and trim shall be set level and plumb.
   g. Spacing of lavatories shall be in accordance with contract documents and jurisdictional codes.

C. Urinals:

1. Wall Mounted

   a. Wall mounted urinal carriers are to be rigidly anchored to the floor structure in accordance with manufacturer's installation instructions.
   b. Wall mounted urinals are to be supported by concealed metal carriers. Transmitting fixture weight loads to the fixture pipe connection will not be acceptable.
   c. Wood or metal mounting plates anchored to the wall framing or studs are not acceptable.
   d. Carriers are to become part of the structure and the urinals shall not exert any weight or stress on the interior wall.
   e. Urinals and trim shall be set level and plumb.
   f. Spacing of urinals shall be in accordance with contract documents and jurisdictional codes.
   g. Install urinals in accordance with manufacturers installation instructions.

D. Service Sink:

1. Install service sink in accordance with manufacturers installation instructions.
2. Terrazzo service sinks shall be set on a minimum of 1/4" of silica free sand bedding shimmed with copper shims.
3. Wall mounted service sink trap standards are to be rigidly anchored to the floor structure in accordance with manufacturers installation instructions.
4. Install mop hangers over service sinks, on wall adjacent and perpendicular to faucet mounting, so mops drain into sink.
5. Install hose brackets and attach hoses to service sink faucets.
6. Service sinks and trim shall be set level and plumb.

E. Electric Water Cooler:

1. Wall Mounted
   a. Electric water cooler carriers are to be rigidly anchored to the floor structure in accordance with manufacturers installation instructions.

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b. Wall mounted electric water coolers are to be supported by concealed metal carriers. Transmitting fixture weight load to the fixture pipe connection will not be acceptable.
c. Wood or metal mounting plates anchored to studs or wall framing will not be acceptable.
d. Carriers are to become part of the structure and the electric water coolers shall not exert any weight or stress on the interior wall.

2. Glass Fillers

a. Glass fillers shall be furnished with pressurized cooling tank, both items shall be factory installed.

F. Sinks:

1. Each sink compartment shall be separately trapped and wasted to wall, continuous waste is not acceptable.
2. Undercounter dishwasher waste shall be provided with air gap fitting through sink backledge and waste to a dishwasher directional tee upstream of sink trap. Do not connect dishwasher to disposer tap inlet.

3. Furnish separate loose key angle or straight stops on dishwasher supplies.

G. Garbage Disposal Units:

1. Garbage disposal units are to be trapped separately from any other fixtures or sink compartments. Two inch minimum.
2. Sinks in which garbage disposers units are installed shall have a waste opening not less than 3-1/2 inches in diameter.

H. Showers:

1. Stall Showers

a. Waste outlets for shower compartment receptors shall be a minimum of 3 inches in diameter with a removable strainer.
b. All shower stalls except those having metal enameled receptors, shall have a lead or copper shower pan or the equivalent thereof as determined in Section 221430.
c. The shower drain grate area shall be not less then 1-1/2 times the free area of the waste pipe.

2. Group/Column Showers

a. Install Group/Column showers in accordance with manufacturers installation instructions.
b. Set column showers absolutely true and plumb.

I. Master Thermostatic Mixing Valves:

1. Install master thermostatic mixing valves in accordance with manufacturers installation instructions. Limit maximum temperature to 110 deg. F. by setting temperature limit stop for handle.

J. Pressure Balance Type Shower Valves:

1. Adjust limit stop control to 110 degrees F maximum temperature. Failure to adjust this control properly may result in serious scalding.

K. Wash Fountains:

1. Install wash fountains in accordance with manufacturers installation instructions.

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2. Provide pressure regulating valves on mixing valves outlet at each fountain.
3. Furnish wash fountains with stop-check supplies with strainer and cast brass trap with cleanouts.
4. Set sprays for appropriate spray pattern.

5. Emergency Eye-Wash Fountains

   a. Furnish shut-off valve supply, and chrome plated brass pipe and fittings, where exposed to view. Install chrome plated pipes without scarring.
   b. Furnish 14" x 3 1/2" aluminum identification signs designed for wall mounting for each eye-wash fountain. Signs shall read: EMERGENCY EYE-WASH FOUNTAIN.
   c. Install emergency eye-wash fountain in accordance with manufacturers installation instructions.

L. Fixture Supplies and Stops:

1. Provide fixture supplies and stops on every individual fixture or appliance.
2. Stops shall be compression by compression types with flexible straight copper tube risers, loose key or wheel handles stops. Provide one key per fixture for all loose key (L.K.) stops.
3. All components, stops, risers, inlet pipe and escutcheon shall be chrome plated brass, polished stainless steel, or special finish as specified for fixture trim.
4. Supplies and stops shall be anchored rigidly behind walls, eliminating push or pull movement.

M. Escutcheon Plates:

1. Provide cast brass chrome plated single piece escutcheons for all penetrations of piping thru walls, floors, or ceilings in finished and unfinished areas.

N. Faucets and Flushometers:

1. Faucets and flushometers shall be anchored rigidly behind walls, eliminating any push or pull movement.

O. Caulking:

1. All wall and floor mounted fixtures shall be caulked with a non-hardening white or fixture color match for colored fixtures adhesive elastomeric sealant compound providing a watertight seal at the joint with the walls or floor.

3.4 ELECTRICAL COORDINATION

A. Coordination of electrical service for all electric water coolers, garbage disposal units and whirlpool tubs will be the responsibility of the Division 23 Contractor in accordance with Section 230529.

3.5 FIXTURE CONNECTIONS

A. Provide supply and waste connections for fixtures in accordance with the following table of minimum sizes or larger to accommodate horizontal fixture branches, as required by jurisdictional codes, or drawings.

Fixture Description:	Hot Water:	Cold Water:	Waste:	Vent:
Water Closet (WC)				
Flush Valve:	NA	1”	4”	2”
Water Closet (WC)				
Tank Operated:	NA	½”	4”	2”
Lavatory (L):	½”	½”	1-1/4”	1-1/4”

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Fixture Description:	Hot Water:	Cold Water:	Waste:	Vent:
Urinal (U):				
Flush Valve:	NA	¾”	2”	1-1/2”
Service Sinks (SS):	½”	½”	3”	1-1/2”
Sink (S):	½”	½”	1-1/2”	1-1/2”
Drinking Fountain (DF):	NA	½”	1-1/4”	1-1/4”
Electric Water Cooler (EWC):	NA	½”	1-1/4”	1-1/4”
Shower (SH):	½”	½”	3”	1-1/2”
Wash Fountains (WF):	½”	½”	2”	1-1/2”
Laundry Tray (LT):	½”	½”	1-1/2”	1-1/2”

3.6 FAUCET OPERATING ROTATION

A. Standard 2 handle faucets shall rotate as follows:

1. Hot Water clockwise to "on", counter clockwise to "off".
2. Cold Water counter clockwise to "on", clockwise to "off".

B. Wrist blade handle faucets:

1. Initial setting at "off" (rest) position shall have handles parallel to the fixture apron or counter front.
2. Hot Water; Counter clockwise to full on (1/4 turn), clockwise to "off".
3. Cold Water; clockwise to full on (1/4 turn), counter clockwise to "off".

3.7 ADJUSTMENT AND CLEANING

A. Adjustment: Adjust all flush valves, faucets, metering devices, shower heads, gas, air and vacuum cocks, and bubblers for proper flow and action after flushing operations are accomplished.

B. Cleaning: Clean all fixtures, trim, accessories and attachments including strainers, traps, aerators, and valves.

3.8 FLUSH VALVE FILTER ‘DIRT GRABBER’

A. Plumbing Contractor shall install a SFDG1 ‘Dirt Grabber’ Flush Valve Filter according to manufacturer’s installation instructions in each urinal or toilet diaphragm-type flush valve manufactured by Sloan or Zurn prior to turning on water to the flush valve, but after water lines have been flushed and disinfected per the specifications.

All other flush valves must contain a filtering device similar to the ‘Dirt Grabber’ to protect the seating area from foreign debris which may enter the flush valve with the water. (The filtering media shall contain openings no larger than .0092” and consist of a minimum of 2-3/4 square inches of filtering material and shall not restrict water flow or result in a reduced volume of water per flush.)

NOTE: The SFDG1 ‘Dirt Grabber’ Flush Valve Filter is manufactured by:

South Fork Manufacturing
798 No. Sage Dr.
Morgan, UT 84050
Phone: 801-953-3001
Fax: 801-829-4146

END OF SECTION 22 44 40

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SECTION 22 44 50 - PLUMBING EQUIPMENT

PART 1 - GENERAL

1.1 WORK INCLUDED

A. Water Heaters and Accessories

1.2 RELATED WORK

A. Requirements: Provide Plumbing Equipment in accordance with the Contract Documents.

B. Section 230500 - Basic Mechanical Requirements.

C. Section 230529 - Basic Mechanical Materials and Methods.

D. Section 230540 - Mechanical Sound and Vibration Control.

E. Section 230548 - Mechanical Seismic Control.

F. Section 221410 - Plumbing Piping.

G. Section 221430 - Plumbing Specialties.

H. Section 231123- Natural Gas Systems.

I. Section 235100 - Breechings, Chimneys, Stacks and Flues.

1.3 SUBMITTALS

A. Submit product specification data for the following items under provision of The General Conditions of the Contract:

1. Water Heaters, Accessories and Controls.

B. Submit printed Operating Instructions and Maintenance Data for the following items under provisions of Operating and Maintenance Data paragraph in Section 230500:

1. Water Heaters and Accessories.

1.4 WARRANTIES

A. Provide original warranties for specific equipment of term specified and in accordance with Section 230500.

PART 2 - PRODUCTS

2.1 PRODUCT ACCEPTANCE

A. Acceptable Manufacturers are listed for each product, and manufacturers shall submit products that are in fact equivalent in all respects of material, design, function, size, and appearance to the manufacturer specified. Deviations of any type will not be acceptable.

B. Where acceptable manufacturers are not listed, only the manufacturer specified will be accepted.

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C. All equipment of like use and nomenclature shall be supplied by one manufacturer only.

2.2 GAS FIRED STORAGE TYPE WATER HEATERS AND ACCESSORIES

A. Acceptable Manufacturers: A.O. Smith, Hatco, Lochinvar, P.V.I. Industries, Rheem, Ruud, State Industries, Bradford White, Thermal Solutions, Armstrong International.

B. Description and Schedule:

1. Provide glasslined tank rated for 150 psi, 300 psi test, ASME Code Construction, AGA Certified, and in conformance with Applicable Energy Code.
2. Provide ASME certified pressure and temperature relief valve, power burner, 100% pilot and main burner safety shut off, electronic spark ignition.
3. Provide flue damper with 100% fail safe feature corrosion resistant enameled steel jacket, blanket or approved foam insulation with minimum insulation factor of R=16, Dielectric Unions for water connections, heavy magnesium anode rod, drain valve, combustion chamber access and manhole as applicable.
4. Schedule: See Drawings
5. Provide three year full non prorated warranty.
6. Burners shall be orificed for equivalent BTUH at altitude of, and calorific value of, gas at point of installation.

2.3 DOMESTIC HOT WATER CIRCULATING PUMPS

A. Acceptable Manufacturers:

1. Taco
2. Bell and Gossett
3. Grundfos
4. Armstrong
5. Patterson

B. Provide in-line type circulating pumps, all bronze construction, bronze face bracket, cast bronze one piece enclosed type impeller hydraulically and dynamically balanced, alloy steel shaft with cupro-nickel shaft sleeve, carbon/ceramic mechanical shaft seal, non metalic noiseless coupler, resilient mounted dry proof motor with sleeve bearings and over load protection, pump bearing and seal assembly shall be replaceable cartridge design, one cartridge and seal to fit all pumps supplied, provide two extra cartridges and seals, oil level dip sticks (one for each pump), and oil drain plug, 125 psig @ 240 deg.F rating.

C. Provide one aquastat pump operating switch for remote mounting. (One switch per pump).

D. Schedule: See Drawings

2.4 WATER HEATER MIXING VALVE (TWV)

A. Acceptable Manufacturer:

1. MCC Powers Process Controls, Bradley.

B. Hydraulically Operated Valve:

1. Three way water mixing valve to proportionally mix hot and cold water, die cast aluminum housing, synthetic diaphragm, cadmium plated spring, Teflon-Asbestos packing ring, ball bearing spring and adjustment. monel stem, stem lubricator, bronze trim and guided valve plugs.

2. Provide reverse acting controller with copper bulb well, for fail safe operation.

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3. Schedule:

PART 3 - EXECUTION

3.1 GAS FIRED STORAGE TYPE WATER HEATERS

A. Set level and plumb, adjust burners to proper flame, set temperature, and verify, to 135 deg.F minimum setting.

B. Provide an expansion tank on the hot water side of all water heaters.

C. Coordinate installation of flue, draft divertor and flue accessories.

D. Provide ASME temperature and pressure relief valve with full size discharge piped and air gapped to nearest floor drain or other acceptable receptacle.

E. Provide hose and drain valve, mixing valve, blending chamber, shut off valves and dielectric connections as required and appropriate.

F. Provide gas connection with gas valve, dirt leg and cap, pressure regulator and pilot control in accordance with Section 231123 – Natural Gas System.

G. Sealed combustion water heaters installed in a negative pressure room will require a ¼” vinyl hose run from the pressure switch to the outdoor atmosphere.

3.2 DOMESTIC HOT WATER CIRCULATING PUMPS

A. Coordinate wall mounted "on-off" toggle switch for pump and electrical power requirements with Division 26 Contractor in accordance with Section 230529 - Basic Mechanical Materials and Methods.

B. Set pump level, plumb and square where indicated on contract documents on vertical pipe leg extended to and supported by floor, provide floor plate and capped leg at floor.

C. Provide drain valve on pump support leg at 18" above floor.

D. Anchor vertical pump leg pipe so as to prevent movement and vibration.

3.3 WATER HEATER MIXING VALVE

A. General:

1. Be responsible to provide or have provided self contained actuator pneumatic supply hydraulic supply electrical power and control wiring and required accessories.
2. Set valve with control bonnet in upright and plumb position.
3. Provide at least 36" clearance between top of blending chamber and any heat holding surface such as ductwork and ceilings.
4. Valve speed adjustment shall be made by authorized factory trained technician. Arrange for these services when building is occupied and in operation.
5. Caution: Valves must be piped in accordance with the contract documents and supplied with appropriate control functions as intended by the designed operation mode, deviations from these intentions may harm the valve and control components, and if the valve is damaged, it shall be replaced, not repaired by the Division 22/23 contractor.
6. Blending chamber connections and piping must be exactly as indicated on the contract documents.
7. Provide "Type L" drawn copper tube blending chamber with 95-5 tin antimony soldered connections. 3/4" NPT at one end (for bulb well), full line size solder connection at bottom

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6" from chamber end (at bulb end) for inlet and full line size solder connection at other end for outlet. Chamber size to be as scheduled in Part 2.

8. Hydraulic and pneumatic valves must be piped as follows, when used with reverse acting "Accritem" controller to effect fail safe operation: IMPORTANT = Hot Water from heater to be piped into "U" port, cold water and hot water recirculating by-pass to be piped into "B" port, tempered water to blending chamber piped from "C" port. DO NOT PIPE THE VALVE FOR STANDARD NON FAIL SAFE CONFIGURATION.

END OF SECTION 22 44 50

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Community School

SECTION 22 44 60 - SPECIAL PLUMBING EQUIPMENT SYSTEMS

PART 1 – GENERAL

1.1 SECTION INCLUDES

A. Grease Interceptor.

B. Manholes, Manhole Frames and Covers.

C. Kitchen Equipment.

D. HVAC Equipment.

1.2 RELATED REQUIREMENTS

A. The General Conditions, Supplementary Conditions and Division 1, General Requirements apply to this Section, and Contractor shall review and adhere to all requirements of these documents.

B. Section 230500 - Basic Mechanical Requirements.

1.3 RELATED SECTIONS

A. Section 230529 - Basic Mechanical Materials and Methods.

B. Section 221410 - Plumbing Piping.

C. Section 221411 - Disinfecting Water Supply System.

D. Section 224450 - Plumbing Equipment.

E. Section 224476 - Swimming Pool Systems.

F. Section 232120 - Process Piping.

1.4 SUBMITTALS

A. Submit Shop Drawings for the following items under provision of The General Conditions of the Contract:

1. Grease Interceptor.
2. Sand, Oil and Gas Trap.
3. Manholes.

B. Submit Product Data for the following items under provision of The General Conditions of the Contract:

1. Manhole Frames and Covers.

C. Submit printed Operating Instructions and Maintenance Data for the following items under provisions of Operating and Maintenance Data paragraph in Section 230500:

1. Grease Interceptor.

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1.5 WARRANTIES

A. Provide original warranties for specific equipment of term specified and in accordance with Section 230500 - Basic Mechanical Requirements.

PART 2 - PRODUCTS

2.1 GREASE INTERCEPTORS (DRAWING CODE GI)

A. Provide grease interceptors for outside installation, constructed of precast concrete with epoxy finish on inside in accordance with jurisdictional authorities requirements, the Contract Documents and acceptable to the Plumbing Code IPC.

B. Interceptors shall be gravity type and rated for continuous flow with 4 minute minimum retention capacity at rated flow rate.

C. Provide manhole extensions to finish grademanhole frames and bolted-gasketed covers flow controls, vents, inlet/outlet piping, and all accessories required. Bolts for interceptor lid access shall be stainless steel type 316 only; cast iron, steel, or brass will not be acceptable.

D. Schedule:

1. Provide "Sure Seal" covers for concrete interceptor.

2.2 MANHOLES, MANHOLE FRAMES AND COVERS

A. Provide manholes of precast. Precast shall consist of 48" dia. Class II type V reinforced concrete in accordance with ASTM C-478. Top section, shall be built up to grade with brick top or concrete grade rings and cover as detailed on Drawings.

B. Provide frames and covers of Grey Iron ASTM Class 45, with lid indexed "Sanitary Sewer" or "Storm Sewer" as applicable:

Make: Neenah Foundry Company
Model: R-1370
Lid: Type C
Index: As Specified above
Features: Non-rocking with minimum size pickhole

2.3 CATCH BASINS

A. Provide catch basins of the types as specified herein and as detailed on the Drawings.

B. Catch basins for use on City, County, or State property shall be constructed and installed in conformance with the jurisdictional authorities' requirements and specifications. These requirements are to be verified before submission of the contract price proposal.

2.4 KITCHEN EQUIPMENT

A. In general most items of kitchen furnishings will be provided by Division 11, or the Owner. Contractor shall verify items of trim and fixtures not furnished by these suppliers and provide all items necessary to complete the installation.

B. When required, the following shall apply:

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1. Traps: Chrome plated cast brass.
2. Tailpieces: Chrome plated 17 gauge copper.
3. Arms: Chrome plated 17 gauge copper.
4. Escutcheons: Chrome plated, cast brass, set screw type.
5. Stops: Chrome plated brass with wheel handle operators.
6. Supplies: Chrome plated type M copper tube.
7. Indirect Wastes: Type "DWV" or "M" copper tube.
8. Water Piping: Type L copper.
9. Waste & Vent Piping: No-Hub Cast Iron System.
10. Gas: Schedule 40 A-120 black steel T&C with malleable fittings up to 1-1/2". 2" and larger schedule 40 A-53 with butt weld steel fittings and couplers.
11. Gas Connectors: When specifically required provide Thermo Tech Co braided flexible connectors with armor shield, approved for gas, and of lengths required for fixed or movable equipment.
12. Couplings: Provide at each end of flexible connector "Hanson Gas Mate" 2-way shut-off couplers and plugs.
13. Solenoid Valves: Provide "ASCO" gas or water rated 2-way solenoid with actuation and reset as required. Refer also to Section 231123.
14. Joints: Where joints of piping systems are welded, soldered or brazed and are exposed to view or cleaning - buff joints to smooth cleanable surface in accordance with N.S.F.

2.5 CASEWORK EQUIPMENT

A. See Part 3 - EXECUTION portion of this Section.

2.6 HVAC EQUIPMENT

A. See Part 3 - EXECUTION portion of this Specification.

PART 3 - EXECUTION

3.1 GREASE INTERCEPTOR

A. Install where shown on Drawings in accordance with jurisdictional authorities.

3.2 SAND OIL AND GAS TRAP

A. Install where shown on Drawings in accordance with jurisdictional authorities.

3.3 NEUTRALIZATION BASIN (Interior and Exterior Type)

A. Provide where shown on Drawings.

B. Provide firm level foundation for all basins 5 gallons or more in size.

C. Provide concrete vault complete with C.I. manhole ring and cover, concrete (dead level) floor, water proofed with membrane exterior to basin and water tight sleeves for piping through vault.

D. Provide 6" diameter fill tube extension to manhole with gas tight cap for replenishment of marble chips from ground level without accessing the basin or entering vault.

E. All basins shall be fully supported on bottom. Do not support from piping. All piping shall be installed without stress.

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F. Fill basin with water, check for leaks and stress and level, add chips to invert level of outlet piping.

3.4 POINT OF USE DILUTION TRAP

A. Provide where shown on Drawings.

B. Set trap on firm base. Do not hang from pipe.

C. Provide wall rough for 6-1/2" ± above trap bottom.

D. Outlet of trap shall be vented, sink tailpiece shall connect to one of the two top inlets provided, and shall have dip tube. The other top inlet shall be provided with a gas tight cap with gasket and made removable for replenishment of the chips. Remove dip tube from this inlet.

E. Provide acid waste piping from trap to connection with building waste or soil system in accordance with Section 221410 - Plumbing Piping.

3.5 MANHOLES FRAMES & COVERS

A. Install where shown on Drawings in accordance with jurisdictional authorities.

3.6 CATCH BASINS

A. Install where shown on Drawings in accordance with jurisdictional authorities.

3.7 DRYWELLS

A. Install where shown on Drawings in accordance with jurisdictional authorities.

3.8 KITCHEN EQUIPMENT

A. Kitchen equipment and appliances will in general be furnished kitchen equipment supplier.

B. Responsibilities shall conform to the following schedule:

C. Schedule: See drawings

D. The Division 22 Contractor shall furnish and install all equipment and trim as scheduled above and as hereinafter specified.

1. Provide traps with cleanouts, tubing waste to wall including escutcheons, of sizes as required.
2. Chrome-plated water supplies and branches complete with individual and branch shut-off chrome-plated valves (globe pattern), and chrome-plated brass escutcheons as required.
3. Gas supplies, complete with lubricated plug valves at point of entry through walls or floors, flexible hose with armor shield from branch to appliance, and connections to the appliance made with "Hanson Gas-Mate" quick coupler type valves only.
4. All extensions of chrome-plated brass indirect waste piping from unit connection to air gapped connections to floor drains or waste receptacles at termination point.
5. All necessary solenoid or motorized valves not furnished as parts of kitchen equipment.
6. All necessary specialties not specifically mentioned, but necessary for proper and complete operation of the unit, or for good appearance and a clean finished contract.

E. All trim and specialties, including valves and piping, shall be chrome plated brass or chrome plated copper where components are not concealed from view. Trim and specialties within cabinets will not be considered concealed.

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3.9 HVAC EQUIPMENT

A. Provide rough-in and final connection to HVAC equipment as indicated on drawings and as required to provide a complete and functional system. Hookups shall include, but not be limited to, the following: evaporative media.

END OF SECTION 22 44 60

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SECTION 23 05 00 - BASIC MECHANICAL REQUIREMENTS

PART 1 - GENERAL

1.1 WORK INCLUDED

A. Basic requirements common to the work in general of Division 21/22/23 and other Divisions and Sections of the Specification where referenced.

B. Provide, unless specified otherwise, all labor, materials and equipment necessary for completely finished and operational mechanical systems described and specified under Division 21/22 and other Sections of this Division 23.

C. Provide all minor incidental items such as offsets, fittings, and accessories required as part of the work even though not specified or indicated.

D. Inspection: Inspect work preceding or interfacing with work of Division 21/22/23 and report any known or observed defects that affect the Work to the Construction Manager/General Contractor. Do not proceed with the work until defects are corrected.

E. Existing Utilities: Are indicated as accurately as possible on the Drawings. Close openings and repair damage in acceptable manner to utilities encountered. This Contractor shall be responsible for field surveying all aspects of existing conditions prior to bid date. Change orders will not be issued for a failure to review existing conditions which affect Division 21/22/23 work.

1.2 RELATED WORK

A. Requirements: Provide Basic Requirements in accordance with the Contract Documents.

1.3 UTILITIES, EXTENSIONS, CONNECTIONS AND FEES FOR WATER AND SEWER

A. Provide all building services extensions and connections to off-site and on-site utilities.

B. Sewer connection charges, typically based on fixture units, that in principle allow the right to obtain the sewer services from the utility will be arranged and paid for by the Division 23 Contractor.

C. Water system development fees, typically based on meter size, that in principle allow the right to obtain the water services from the utility will be arranged and paid for by the Owner.

D. Sewer tap fees as they are known to the trade and are the charges for actual materials and labor for tapping, inspection and recording of the tap shall be arranged and paid for by the Owner.

E. Water tap fees as they are known to the trade and are the charges for actual materials and labor for tapping, inspection and recording of the tap shall be arranged and paid for by the Owner.

F. In the event that the serving utility company installs their own taps, service, meters, etc., all costs imposed by this action shall be paid for by the Division 23 Contractor. Extensions from termination points to connection with building services and systems will be the responsibility of the Division 23 Contractor.

G. Be responsible for all pads, vaults, manholes, manhole covers, meter enclosures, valves, services boxes, and the like, all in conformance with requirements of the serving utility company.

H. In the event that the water service to the building is a combination domestic and fire protection service, the responsibility of said "combination service" to the point of domestic connection shall be that of a licensed Fire Protection Contractor, including tap, valves, excavation, backfill, compaction

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and meters, if any. After point of domestic connection, responsibility for separate fire and domestic services is with appropriate trades including all labor and materials as herein before mentioned.

1. Contractor shall coordinate with other trades all interface piping and types of connections to be provided for interface.
2. Provide fire hydrant, auxiliary gate valve, tapping sleeve and valve or tee, service boxes, and anchor or swivel couplings, thrust blocks, deadmen, rods, and the like, all in conformance with the requirements of serving utility company.

1.4 REFERENCES

A. General:

1. For products or workmanship specified by association, trade, or Federal Standards, comply with requirements of the standard, except when more rigid requirements are specified or are required by applicable codes.
2. The date of the standard is that in effect at the date of the Contract Documents, except when a specific date is specified.
3. When required by individual Specification sections, obtain copy of standard. Maintain copy at job site during work until substantial completion.

B. Schedule of Referenced Organizations: The following is a list of the acronyms of organizations referenced in these Specifications:

ADC	Air Diffusion Council 1000 E. Woodfield Rd. Schaumburg, IL 60173 www.flexibleduct.org
AGA	American Gas Association 400 No. Capitol St. N.W. Washington, DC 20001 www.aga.org
AMCA	Air Movement and Control Association 30 West University Drive Arlington Heights, IL 60004 www.amca.org
ANSI	American National Standards Institute 1819 L Street N.W. Washington, DC 20036 www.ansi.org
ARI	Air Conditioning and Refrigeration Institute 4301 No. Fairfax Drive. Arlington, VA 22203 www.ari.org
ASHRAE	American Society of Heating, Refrigeration and Air Conditioning Engineers 1791 Tullie Circle, N.E. Atlanta, GA 30329 www.ashrae.org
ASME	American Society of Mechanical Engineers Three Park Avenue New York, NY 10016 www.asme.org

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ASPE	American Society of Plumbing Engineers 8614 W. Catalpa Ave. Chicago, IL 60656 www.aspe.org
ASSE	American Society of Sanitary Engineering 901 Canterbury Westlake, OH 44145 www.asse-plumbing.org
ASTM	American Society for Testing and Materials 100 Barr Harbor Dr. West Conshohoeken, PA 19428 www.astm.org
AWS	American Welding Society 550 N.W. LeJeune Rd. Miami, FL 33126 www.aws.org
AWWA	American Water Works Association 6666 West Quincy Avenue Denver, CO 80235 www.awwa.org
CDA	Copper Development Association 260 Madison Avenue New York, NY 10016 www.copper.org
CISPI	Cast Iron Soil Pipe Institute 5959 Shallow Ford Rd., Suite 419 Chattanooga, TN 37421 www.cispi.org
CS	Commercial Standard of NBS (U.S. Dept. of Commerce, National Institute of Standards and Technology) Government Printing Office Washington, D.C. 20402
CTI	Cooling Technology Institute 530 Wells Fargo Drive Houston, TX 77090 www.cti.org
ICC	International Code Council 5203 Leesburg Pike, Suite 600 Falls Church, VA 22041 www.intlcode.org
IAPMO	International Association of Plumbing and Mechanical Officials 20001 E. Walnut Drive South Walnut, CA 91789 www.iapmo.org
NEBB	National Environmental Balancing Bureau 8575 Grovemont Circle Gaithersburg, MD 20877 www.nebb.org

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NEC	National Electric Code (of NFPA)
NEMA	National Electric Manufacturer's Association 1300 N. 17th Street Rosslyn, VA 22209 www.nema.org
NFPA	National Fire Protection Association One Batterymarch Park P.O. Box 9101 Quincey, MA 02269 www.nfpa.org
NSF	NSF International 789 No. Dixboro Rd. Ann Arbor, MI 48113 www.nsf.gov
OSHA	Occupational Safety Health Administration (U.S. Dept. of Labor) Government Printing Office Washington, D.C. 20402 www.osha.gov
PDI	Plumbing and Drainage Institute 45 Brystal Drive South Easton, MA 02375 www.pdionline.org
SMACNA	Sheet Metal and Air Conditioning Contractor's National Association 4201 Lafayette Center Drive Chantilly, VA 20151 www.smacna.org
UL	Underwriters Laboratories, Inc. 333 Pfingston Rd. Northbrook, IL 60062 www.ul.com

1.5 DEFINITIONS

A. Specification Language Explanation: These Specifications are of abbreviated, simplified or streamlined type and include incomplete sentences. Omissions of words of phrases such as "the Contractor shall", "in conformity therewith", "shall be", "as noted on the drawings", "a", "the", are intentional. Supply when "NOTE" occurs on Drawings. Supply words "shall be" or "shall" by inference when colon is used with sentences or phrases. Supply words "on the Drawings" by inference when "as indicated" is used with sentences or phrases. Singular words will be interpreted as plural and plural words will be interpreted as singular where applicable and where full context of the Contract Documents so indicates.

B. Furnish: Except as otherwise defined in greater detail, term "furnish" is used to mean supply and deliver to Project site, ready for unloading, unpacking, assembly, installation, etc., as applicable in each instance.

C. Install: Except as otherwise defined in greater detail, term "install" is used to describe operations at Project site including unloading, unpacking, assembly, erection, placing, anchoring, applying, working to dimension, finishing, curing, protecting, cleaning and similar operations, as applicable in each instance.

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D. Provide: Except as otherwise defined in greater detail, term "provide" means furnish and install, complete and ready for intended use, as applicable in each instance.

E. Indicated: The term "Indicated" is a cross-reference to graphics, notes or schedules on Drawings, to other paragraphs or schedules in the Specifications, and to similar means of recording requirements in contract documents. Where terms such as "shown", "noted", "scheduled", and "specified" are used in lieu of "indicated", it is for purpose of helping reader locate cross-reference, and no limitation of location is intended except as specifically noted.

F. General Contractor: The term "General Contractor" used in Division 23 and elsewhere in the Contract Documents means the party with whom the Owner has executed the Owner-Contractor Agreement.

G. Approved Equal: Except as otherwise defined in greater detail, term "approved equal" means that any materials, equipment, work procedures and techniques shall be either addressed on the drawing, specifications or addendum by manufacturer or by detailed material description. When brand names are referenced it implies that only the manufacturers listed are approved. All approved material, equipment, work procedures, and techniques will be noted in the specifications, drawings, or by addendum prior to bid date. Items not approved in this manner will not be considered.

1.6 QUALITY ASSURANCE

A. Quality Control:

1. Materials and apparatus required for the work to be new and of first-class quality; to be furnished, delivered, erected, connected and finished in every detail; and to be so selected and arranged so as to fit properly into the building spaces. Where no specific kind or quality of material is given, a first-class standard article shall be furnished.
2. Furnish the services of an experienced superintendent, who will be constantly in charge of the installation of the work, together with all skilled workmen, fitters, metal workers, certified welders, plumbers, millwrights, sprinkler fitters, drain layers, helpers, and labor required to unload, transfer, erect, connect, adjust, start, operate and test for each system.
3. Unless otherwise specifically indicated, equipment and materials to be installed in accordance with the recommendations of the manufacturer. This includes the performance of tests as recommended by the manufacturer.

B. Proof of Performance:

1. Division 23 Contractor shall provide proof of performance certification of all Mechanical Equipment and Systems to demonstrate that all Mechanical Equipment and Systems are operating to the intent of the design. This proof of performance shall include, but shall not be limited to, actual demonstration of all temperature/pressure control loops, operation of all heating/cooling equipment and other required tests upon request by the Engineer or Owner. A signed certificate from the piping, sheet metal, control, and balancing subcontractors stating that they have personally checked the operation of all equipment and control loops and that everything under their subcontract is operating as specified. These certificates shall be furnished to the 230593 Contractor for inclusion in the Operation and Maintenance Manual.

1.7 REGULATORY REQUIREMENTS

A. Execute work per Underwriters, Public Utility, Local and State Codes, Ordinances and applicable regulations. Obtain and pay for required permits, inspections, and certificates. Notify Architect of items not meeting said requirements.

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B. Comply with editions of all applicable codes, ordinances and regulations in effect at the time of bid opening including but not necessarily limited to the following:

International Mechanical Code
International Plumbing Code
International Fuel Gas Code
International Energy Conservation Code
State Department of Health Requirements
State Energy Code
National Fire Protection Association Standards
International Fire Code
International Building Code
National Electrical Code NFPA-70
State Boiler Code
Jurisdictional County Health Department
Jurisdictional City Wastewater Management Division or District
Jurisdictional City Water Department
Jurisdictional Water Conservation Standards

C. If discrepancies occur between the Contract Documents and any applicable codes, ordinances, acts, or standards, the most stringent requirements shall apply.

D. Where hourly fire ratings are indicated or required, provide components and assemblies meeting requirements of the IBC, and listed by Underwriters Laboratories, Inc.

1.8 SUBMITTALS

A. Submit Samples, Shop Drawings and Product Data as required by various Sections of Division 23 in accordance with The General Conditions of the Contract. The Contractor agrees that these Submittals processed by the Engineer are not Change Orders; that the purpose of these Submittals by the Contractor is to demonstrate to the Engineer that the Contractor understands the design concept, that he demonstrates his understanding by indicating which equipment and material he intends to furnish and install and by detailing the fabrication and installation methods he intends to use. Contractor further agrees that if deviations, discrepancies, or conflicts between these Submittals and the Contract Documents in the form of design drawings and specifications are discovered either prior to or after these Submittals are processed by the Engineer, the Design Drawings and Specifications shall control and shall be followed.

B. The submittals shall be submitted in a single package with all mechanical equipment for the project enclosed. The submittals shall be enclosed in a stiff back, 3-ring binder. All mechanical equipment shall be separated with tabbed index cards with an indexed legend provided in the front of the binder. In the event submittals are submitted in electronic format, the submittal shall be in the form of a single PDF file in which all equipment has been electronically bookmarked and all bookmarks have been identified using the equipment tags used on the drawings. Individual PDF files for separate pieces of equipment or specification sections will not be accepted.

C. Test Reports: Submit certified test reports as required by various Sections of Division 23 showing compliance in accordance with General Conditions of the Contract. Signed copies shall be included in the Operation and Maintenance Manual.

D. Operating Instructions and Maintenance Data: Prepare and submit printed operating instructions and maintenance data in accordance with Operating and Maintenance Data paragraph in this Section.

E. Submittals will be reviewed and marked as follows:

1. No Exceptions Taken: No action required.
2. Make Corrections Noted: Correct the submittals per notes by engineer and submit new copies of submittal to contractor for project records. Do not resubmit to engineer.

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3. Rejected: Equipment as submitted does not meet requirements of contract documents. Revise and/or clarify per comments and resubmit to engineer.
4. Submittal Not Requested: Submittal not required per specification. Submittal returned with no review.

F. Note that the submittal review process does not relieve Contractor from being ultimately responsible for ensuring that submitted items satisfy all requirements of the Contract Documents.

G. Site Condition and Coordination:

1. Before any ductwork is fabricated or equipment installed and before running and/or fabricating any lines of piping or ductwork, the Contractor shall provide Architect and Engineer ¼" scale drawings of all mechanical rooms and main access walkways, coordinated with all trades with submitted equipment and verify all other areas to assure himself that they can be run and installed as contemplated in cooperation with Contractors of other Divisions of the Work and the physical constraints of the Structural and Architectural Work and maintain access walkways are clear for maintenance.

1.9 PRODUCT OPTIONS AND SUBSTITUTIONS

A. Substitutions and Prior Approvals: Substitutions and prior approvals will be acceptable only when the proposed substitute has been submitted to the Engineer and approved through an addendum or change order. Request for prior approval shall be submitted a minimum of 10 calendar days prior to bid.

B. Some materials and equipment are specified by manufacturer and catalog numbers. The manufacturer and catalog numbers are used to establish a degree of quality and style for such equipment and material.

C. NOTE: When alternate or substitute materials and equipment are used Division 23 Contractor shall be responsible for engineering/redesign costs, space requirements, configurations, performance, changes in bases, supports, structural members and openings in structure, electrical changes and other apparatus and trades that may be affected by their use. Notification of General Contractor and other affected subcontractors shall be the responsibility of the Division 23 Contractor.

1.10 PROJECT RECORD DOCUMENTS

A. General: Comply with Division 1.

B. Job Site Documents: Maintain at the job site, one record copy of the following:

1. Drawings
2. Specifications
3. Addenda
4. Reviewed Product Submittals and Shop Drawings
5. Field Test Records

Do not use record documents for construction purposes. Maintain documents in clean, dry legible condition, apart from documents used for construction.

C. Record Information: Label each document "Record Document". Mark information with red ink. Keep each record current. Do not permanently conceal any work until required information is recorded.

D. Record following information on Drawings:

1. Horizontal and vertical location of underground utilities to be dimensioned from column lines.
2. Dimensioned location of internal utilities and appurtenances concealed in construction.

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3. Field changes of dimension and detail.
4. Changes by change order or field order.
5. Details not on original contract drawings.
6. Manufacturer, trade name, catalog number and supplier of each product and item of equipment actually installed shall be indicated on equipment schedules.

E. Record the following information on Specifications:

1. Changes by change order or field order.
2. Other matters not originally specified.

F. Shop Drawings: Maintain shop drawings as record documents recording changes made after review as specified for drawings above.

G. Submittal: At completion of project, deliver record documents to Owner's representative and transmit a copy of signed receipt from Owner to the Engineer.

1.11 OPERATING AND MAINTENANCE DATA

A. The "Operating and Maintenance Manual" (O & M) is a bound compilation of descriptive drawings and data which identify equipment installed at the project site and detail the procedures and parts required to maintain and repair the equipment. Copies of final reviewed submittals shall be included for all equipment items.

B. Five sets of bound manuals will be required for this project. These are to be submitted for approval to the Project Manager. Five electronic versions of the manuals are also required, as described in paragraph I below.

C. Organization of the manuals shall follow the recommendations in ASHRAE Guideline current edition.

D. Enclose the material in rigid 3-ring or metal post binders and submit to the Project Manager at the completion of the project. Binders shall be Buckram or metal post binders or prior approved equal with block lettering. Simple binders with slide-in cover sheets are not acceptable. Sheet size shall be 8-1/2" x 11" with expandable metal capacity as required for the project. The number of binders forming one O & M Manual shall be based on a maximum limit of 4 inches. The following information shall appear on the front cover and backbone:

1. "Operation and Maintenance Manual"
2. Project Name (and volume number if more than one volume)
3. Project number
4. Building name, number, and street address
6. * Architect's name
7. * Engineer's name
8. * General Contractor's name
9. * Mechanical Contractor's name

* Items "6" through "9" need not be printed on the backbone.

E. Pages are to be standard 8-1/2" x 11" sheets, or 11" x 17" folded to fit the 8-1/2" x 11" sizes.

F. The manual shall include the following:

1. Alphabetical list of all system components including the name, address, and 24-hour phone number of the company responsible for servicing each item during the first year's operation.
2. Operating instructions for complete system, including emergency procedures for fire or failure of major equipment and procedures for normal starting/operating/shutdown and long-term shutdown

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3. Maintenance instructions, including valves, valve tag and other identified equipment lists, proper lubricants and lubricating instructions for each piece of equipment and necessary cleaning/replacing/adjusting schedules.
4. All test reports and proof of performance certificates.
5. Manufacturer's data and instruction sheets for each piece of equipment, marked to indicate the plan symbol, model, number, and options installed for each item of equipment furnished and installed on the project. These data sheet shall be accompanied by reviewed submittals that had no exceptions taken to them. Provide original printed material in each book, faxes are NOT acceptable. The serial numbers of each item of equipment installed are to be listed with the model numbers and plan symbols.

    a. Installation instructions.
    b. Drawings and specifications (final shop drawings).
    c. Complete parts lists, and a source of supply for each piece of equipment, marked with model, size, and plan symbol.
    d. A copy of the reviewed submittals for each piece of equipment, with any/all corrections identified during the submittal process made to the final submittal documents.
    e. Performance curves and capacity data, marked with model number, size, and plan code.
    f. Complete “as-builts” wiring and temperature control diagrams. (Shop drawings are not acceptable).
    g. Lubrication and other preventative maintenance data.
    h. Equipment warranties.
    i. The final balance report.

6. Design Intent Document furnished by Engineer.
7. Include a Table of Contents and tabbed index dividers.

G. In addition to the maintenance manual, and keyed to it, the equipment shall be identified and tagged as specified on drawings. Insert a copy of the Equipment List or Equipment Schedules in manual.

1. Identify all starters, disconnect switches, and manually operated controls, except integral equipment switches. Label with permanently applied, legible markers corresponding to operating instructions in the "Maintenance Manual".
2. Tag all valves per requirements in Section 230529.
3. Provide a typed tag list or schedule laminated or mounted under plexiglass in the equipment room stating valve ID number, location, service or function of each tagged item, and normal valve position. Insert a copy of tag list in each "Maintenance Manual". Also provide one copy of the list in a plastic closure as manufactured by Seton Name Plant Company, New Haven, Conn; or approved equal. The plastic closure shall include two holes punched at the top, with a brass or nickel grommet in each hole, and an 8” long length of nickel plated bead chain run through the holes, allowing the list to be hung from a wall peg.
4. Provide a reduced scale drawing of each floor indicating the location of each manual and automatic valve in every HVAC and plumbing piping system and include valve position number and normal valve position (normally open/normally closed) as per Specification Section 230529. Mount all drawings under plexiglass or laminate and mount on equipment room wall.

H. Division 230593 Contractor shall be responsible for scheduling instructional meetings for maintenance personnel on the proper operation and maintenance of all mechanical systems, using the maintenance manual as a guide. These meetings must be scheduled through the Architect, Construction Manager/General Contractor and far enough in advance so that all necessary personnel can be adequately notified.

1. Submit training certificate to Owner’s Representatives at end of training and have certificate signed to indicate adequate training has been received.

I. Operating and Maintenance Data documents must be provided in digital format as follows:

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1. Provide O&Ms in an intuitive format on a CD-ROM or DVD. Electronic manual preparation shall be under the direction of an individual or organization that has demonstrated expertise in the preparation of a comprehensive and complete electronic operation and maintenance manual. Qualifications shall be submitted for approval. One source of procurement used on past projects is Emanuals by Scanitall in Sandy, UT (tel. 801-619-2082). This is the responsibility of the Division 21/22/23 contractor.
2. A single CD or DVD to be authored with the latest edition of Adobe Acrobat, and be in a "non-protected" network accessible format.
3. All information on the CD-ROM or DVD shall be printable on 8.5"x11" or 11"x17"plain paper.
4. Capture images using OCR technology such that the user can key word search for information.
5. Provide a hypertext alphabetical index of all equipment and building products. All hypertext shall be blue in color.
6. Provide 3 copies of the O&M CD-ROM or DVD.

1.12 DELIVERY, STORAGE AND HANDLING

A. General: Deliver and store materials and equipment in manufacturer's unopened containers fully identified with manufacturer's name, trade name, type, class, grade, size and color.

B. Protection: Store materials and equipment off the ground and under cover, protected from damage. Maintain caution labels on hazardous materials.

C. Large Items: Make arrangements with other contractors on the job for introduction into the building of equipment too large to pass through finished openings.

D. Handling of Materials: Materials shall be handled, sorted and distributed using appropriate handling methods to protect all materials from damage. Dented, rusted, corroded or otherwise damaged materials shall be removed from the project site. Lined ductwork on which the liner becomes wet shall be removed from the project site. Determination of materials deemed unusable or inappropriate for installation shall be made by the Architect/Engineer.

1.13 PROJECT CONDITIONS

A. Accessibility:

1. Division 23 Contractor shall be responsible for the sufficiency of the size of shafts and chases and the adequate clearance in double partitions and hung ceilings for proper installation of his work. He shall cooperate with Contractors of other Divisions of the Work whose work is in the same space and shall advise the Construction Manager/General Contractor of his requirements. Such spaces and clearances shall, however, be kept to the minimum size required.
2. Division 23 Contractor shall locate all equipment which must be serviced, operated, or maintained in fully accessible positions. Equipment shall include (but not be limited to) valves, shock absorbers, traps, cleanouts, motors, controllers, switchgear, filters, VAV boxes, control valves, balancing valves, and drain points. If required for better accessibility, furnish access doors for this purpose. Minor deviations from Drawings may be allowed to provide for better accessibility. Any changes shall be approved by the Architect/Construction Manager/General Contractor prior to making the change.
3. Division 23 Contractor shall provide the Construction Manager/General Contractor with the exact locations of access doors for each concealed valve, damper, or other device requiring service. Locations of these doors shall be submitted in sufficient time to be installed in the normal course of work.

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B. Fabrication:

1. Before any ductwork is fabricated and before running and/or fabricating any lines of piping or ductwork, the Contractor shall assure himself that they can be run as contemplated in cooperation with Contractors of other Divisions of the Work and the physical constraints of the Structural and Architectural Work.

C. Freeze Protection:

1. Do not run lines in outside walls, or locations where freezing may occur. Piping next to outside walls shall be in furred spaces with insulation between the piping and the outside wall. Insulation of piping shall not be considered freeze protection. Buried pipe shall be installed minimum 6” below frost depth, unless noted otherwise in the documents.

D. Scaffolding, Rigging and Hoisting:

1. Provide all scaffolding, rigging, hoisting and services necessary for erection and delivery into the premises of any equipment and apparatus furnished; remove same from premises when no longer required.

1.14 COORDINATION

A. General: Coordinate and order the progress of mechanical work to conform to the progress of the work of the other trades. Complete the entire installation as soon as the condition of the building will permit.

B. Coordination with Electrical Work: Section 230529.

C. Utility Interruptions: Coordinate mechanical utility interruptions with the Owner and the Utility Company. Plan work so that duration of the interruption is kept to a minimum.

D. Cutting and Patching: Section 230529.

E. Drawings and Specifications: The Mechanical Drawings indicate the general design and arrangement of lines, equipment, systems, etc. Information shown is diagrammatic in character and does not necessarily indicate every required offset, fitting, etc. Do not scale the Drawings for dimensions. Take dimensions, measurements, locations, levels, etc., from the Architectural Drawings and equipment to be furnished.

F. Each Division 23 subcontractor shall coordinate with other contractors to make certain that any of his equipment, piping or ductwork which is mounted on isolators or flexibly connected does not become "grounded" by another contractors work (e.g. walls, ceiling, etc.).

G. Discrepancies: Examine Drawings and Specifications for other parts of the work, and if any discrepancies occur between the plans for the work of this Division and the plans for the work of others, report such discrepancies to the Construction Manager/General Contractor and obtain written instructions for any changes necessary.

H. Order of Precedence: The precedence of mechanical construction documents are as follows:

1. Addenda and modifications to the Drawings and Specifications take precedence over the original Drawings and Specifications.
2. Should there be a conflict within the Specifications or within Drawings of the same scale, or between the Specifications and the Drawings, the more stringent or higher quality requirements shall apply.
3. In the Drawings, the precedence shall be Drawings of larger scale over those of smaller scale, figured dimensions over scaled dimensions and noted materials over graphic indications.

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4. Should there be a conflict in dimensions or locations between Mechanical Drawings and Architectural Drawings, the Architectural Drawings shall have precedence.

1.15 START-UP PROCEDURES

A. Before start-up, each piece of equipment comprising a part of the system shall be checked for proper lubrication, drive rotation, belt tension, proper control sequence, and any other condition which may cause damage to equipment or endanger personnel.

B. Insure that all control systems are fully operational in automatic mode. Individually test each control loop to make certain it is operating as intended and is communicating properly with other devices.

C. If systems are not to continue in use following the start-up procedures, steps should be taken to insure against accidental operation or operation by unauthorized personnel. Provide padlocks on disconnect switches where applicable.

D. Factory personnel shall be notified as appropriate to start systems requiring their services.

E. Notify engineer at least 2 weeks prior to the scheduled start-up date of all major mechanical equipment and systems.

1.16 SCHEDULE OF TESTING

A. Provide testing in accordance with the General Conditions of the Contract.

B. A schedule of testing shall be drawn up by the Division 23 Contractor in such a manner that it will show areas tested, test pressure, length of test, date, time and signature of testing personnel.

C. All testing must be performed in the presence of the Architect's/Construction Manager's/General Contractor's representative; his signature for verification of the test must appear on the schedule.

D. All testing must be performed in accord with the procedures set forth in Division 23 and other Sections of the Specifications where referenced. At completion of testing, the completed schedule shall then be submitted in triplicate to the Architect and a copy shall be forwarded to the 230593 Contractor for inclusion in Operation and Maintenance Manual.

E. Make all specified tests on piping, ductwork and related systems as specified in this specification.

F. Make sure operational and performance tests are made on seasonal equipment.

G. Complete all tests required by Code Authorities, such as smoke detection, life safety, fire protection and health codes.

H. After test runs have been completed and systems have been demonstrated to be satisfactory and ready for permanent operation, all permanent pipeline strainers and filters shall be cleaned, air filters cleaned or replaced, settings on pressure relief valves properly adjusted, valve and pump packings properly adjusted, belt tensions adjusted, drive guards secured in place, lubrication checked and replenished if required.

1.17 CLEANING AND FINISHING

A. Provide cleaning in accordance with the General Conditions of the Contract and Division 1.

B. Cleaning shall include but not be limited to removing grease, dirt, dust, stains, labels, fingerprints and other foreign materials from sight-exposed piping, ductwork, equipment, fixtures and other such items installed under Division 23 of the work. If finishes have been damaged, refinish to original condition and leave everything in proper working order and of intended appearance.

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C. Section 232113 Contractor shall be responsible to certify that all HVAC Piping Systems have been cleaned in accordance with Section 232500 - HVAC Water Treatment whether actually done by the Section 232113 Contractor or by the 232500 Contractor.

1.18 WARRANTIES

A. Warranty: Provide a written warranty to the Owner covering the entire mechanical work to be free from defective materials, equipment and workmanship for a period of one year after Date of Acceptance. During this period provide labor and materials as required to repair or replace defects. Provide certificates for such items of equipment which have warranties in excess of one year. Submit to the Construction Manager/General Contractor for delivery to the Architect. Include a copy of all warranties in the Operation and Maintenance Manual.

B. This warranty will be superseded by the terms of any specific equipment warranties or warranty modifications resulting from use of equipment for construction heat or ventilation.

C. All refrigeration compressors shall have a (4) four year extended warranty from the manufacturer of the equipment in addition to the standard one-year warranty.

1.19 PROJECT CLOSEOUT

A. Project Observation Reports:

At or near the completion of the construction phase of this project, the Engineer will generate one or more Project Observation Reports for the owner. These reports will list the items of construction observed by the Engineer which are not in compliance with the Contract Documents.

The Mechanical Contractor and/or subcontractors shall certify completion of each listed item in writing and forward copies to the Architect, Engineer and General Contractor. The Engineer will not recommend the payment of retainage until this compliance certification has been received.

Each item on the Project Observation Report shall have a signature/date in the margin of the report indicating completion of that item.

1.20 CERTIFICATES AND KEYS

A. Certificates: Upon completion of the work, deliver to the Construction Manager/General Contractor one copy of Certificate of Final Inspection.

B. Keys: Upon completion of work, submit keys for mechanical equipment, panels, etc. to the Construction Manager/General Contractor.

END OF SECTION 23 05 00

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SECTION 23 05 29 - BASIC MECHANICAL MATERIALS AND METHODS

PART 1 - GENERAL

1.1 RELATED WORK

A. The General Conditions, Supplementary Conditions and Division 1, General Requirements apply to this Section, and Contractor shall review and adhere to all requirements of these documents.

B. Work furnished but not installed by this Contractor:

1. Access doors in accordance with paragraph 2.3 in this Section 230529.

1.2 SYSTEM DESCRIPTION

A. The work includes, but is not limited to the following:

Materials and methods common to the work in general of Division 23 and other Divisions and Sections of the Specifications where referenced.

1.3 QUALITY ASSURANCE

A. Welder Qualifications: Welding shall be performed by an ASME Certified welder with current certificate in accordance with ANSI B31.1 for shop and project site welding of piping work. Welder Qualifications:

1. Each welder shall have passed a qualification test within the past 6 months.
2. The test shall be in accordance with the ASME Boiler and Pressure Vessel Code, Section IX, "Welding Qualifications", ASME Section VIII, and ANSI 313.
3. The test report shall certify that the welder is qualified to weld the material to be used at the job site.
4. The Contractor shall submit three copies of each welder's qualification test report to the Project Manager for approval prior to commencing the work. No welder shall be used on the project until so certified.

1.4 REFERENCES

A. Reference Standards: Except as modified by governing codes and by the Contract Documents, comply with the applicable provisions and recommendations of the following:

1. For electrical equipment and products, comply with applicable National Electrical Manufacturers Association (NEMA) Standards, and refer to NEMA Standards for definitions of terminology herein.
2. Comply with National Electrical Code (NEC) NFPA-70 for electrical installation requirements.
3. Certified Pipe Welding Bureau (NCPWB) and American National Standards Institute (ANSI) Code Numbers B31.2, & B31.9 as applicable for welding requirements.
4. Comply with American National Standards Institute (ANSI A13) for identification of piping systems.
5. Comply with American National Standards Institute (ANSIB31.1) Code for Pressure Piping.

1.5 SUBMITTALS

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A. Shop Drawings: Submit Shop Drawings and Product Data for the following items in accordance with the General Conditions of the Contract:

1. Legend and color of piping and equipment identification
2. Freeze Protection Systems for Piping and Equipment (Heat Tracing).
3. Domestic Hot Water Heat Maintenance System.

B. Operating Instructions and Maintenance Data: Submit printed Operating Instructions and Maintenance Data for the following items in accordance with Operating and Maintenance Data Paragraph in Section 230500.

1. Motors.
2. Starters.

C. Certificates: Before proceeding with the Work, submit to the Architect/Construction Manager/General Contractor, two copies of Certification that the welding work will be done according to ANSI B31.1 by welders who have been tested and whose qualification test sheets are available, attesting to their ability to weld in accordance with the Standard Procedure Specifications as established by the National Certified Pipe Welding Bureau.

PART 2 - PRODUCTS

2.1 MOTORS

A. General: Furnish motors necessary to operate mechanical equipment.

B. Motor Characteristics: Comply with the following requirements:

1. Variable Speed Drive Compatibility: All motors which are powered through a variable frequency drive shall conform to NEMA MG-1, Part 31 for inverter duty and shall be capable of continuous operation at 20% of nominal speed and shall meet the requirements of the Variable Frequency Drive specification in Section 230810 or Division 26 as applicable.
2. Altitude Deration: Motors to be furnished to maintain specified rated service factor at altitude of project.
3. NEMA Temperature Rating: Rated for 40 deg.C environment for continuous duty at full load, Class B motor temperature rise. Motors for use with variable frequency drives shall be Class F insulated.
4. Starting Capability: Provide each motor capable of making starts as frequently as indicated by the automatic control system.
5. Phases and Current Characteristics: Provide squirrel-cage induction polyphase motors for 3/4 horsepower and larger, and provide capacitor-start single-phase motors for 1/2 horsepower and smaller. One-sixth horsepower and smaller may, at equipment manufacturer's option, be split-phase type. Coordinate current characteristics with power specified in Division 26 and with individual equipment requirements specified in other Sections of Division 23. Provide two separate windings on polyphase two speed motors. Do not purchase motors until power characteristics available at locations of motors have been confirmed, and until rotation directions have been confirmed.
6. Power Factor: All motors rated greater than 1000 watts shall have a Power Factor of not less than 95% under rated load conditions. The 95% PF may be obtained by design of the motor or by providing a capacitor. Capacitors, if provided to obtain the 95% PF, must be switched with the motor. If the motor draws less than 1000 watts at full load, it is excluded from the 95% power factor requirement.
7. Service Factor: 1.15 for polyphase motors and 1.35 for single-phase motors. Motors shall be selected such that the brake horsepower requirement is not within the service factor at design load.
8. Efficiency: All motors shall be premium efficiency type in accordance with the current State Energy Code, except where a higher efficiency is noted on drawings.
9. Motor Construction: Provide Design "B" motors for general purpose continuous duty and Design "C" motors where required for high starting torque such as the low speed motor on

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fans with a two-motor drive arrangement. Small motors that are part of packaged equipment may be manufacturer's standard motors meeting Energy Code requirements for efficiency.

a. Bearings: Ball or roller bearings with inner and outer shaft seals: regreasable; except permanently sealed where motor is normally inaccessible for regular maintenance. Where belt drives and other drives produce lateral or axial thrust in the motor, provide bearings designed to resist the thrust loading. Refer to individual sections of Division 23 for fractional horsepower light-duty motorized equipment where sleeve-type bearings are permitted.
b. Enclosure Type: Except as otherwise indicated, provide open drip-proof motors for indoor use where satisfactorily housed during operation, and provide guarded drip-proof motors where exposed to contact by employees or building occupants. Provide weather-protected Type I for outdoor use, Type II where not housed. Refer to individual Sections of Division 23 for other enclosure requirements.
c. Overload Protection: Provide built-in thermal overload protection for each leg of each phase and, where indicated, provide internal sensing device suitable for signaling and stopping the motor at the starter. Thermal overload protectors shall be sized to accommodate the altitude of installation.
d. Name Plate: Provide metal nameplate on each motor, indicating full identification of manufacturer, ratings, characteristics, construction, NEMA efficiency, power factor, special features and similar information.
e. Motor Connections: Provide conduit connection boxes.
f. Motors shall not exceed 80dbA rating when running their full speed and power range.

2.2 STARTERS

A. Note that some starters are furnished and installed under Division 26. Review electrical plans before bidding.

B. General: Furnish starters and contactors necessary to operate mechanical equipment motors. **Starter manufacturer shall be the same brand for ALL motors furnished under Division 23.** Approved manufacturers shall be those listed in Division 26 or this specification.

C. Motor Starter Characteristics: Comply with NEMA standards and NEC. Furnish Type I general purpose enclosures with padlock ears, and with frames and supports for mounting on wall, floor or panel as required. Furnish the type and size of starter recommended by the motor manufacturer and equipment manufacturer for the applicable protection and start-up condition; refer to individual equipment sections for basic load requirements. All starters shall be by the same manufacturer. Only manufacturers approved by Division 26 will be accepted. All starters shall comply with Division 26 requirements.

D. Manual Control:

1. Furnish maintained-contact push buttons and pilot lights, properly arranged for single-speed or multi-speed operation as indicated.
2. Furnish manual switch and pilot light for motors 1/3 horsepower and smaller, except where interlock or automatic operation is indicated.

E. Automatic Control:

1. Furnish magnetic starters for motors 1/2 horsepower and larger and for smaller motors where interlock or automatic operation is indicated. Include the following:

a. Maximum number of auxiliary contacts available: three or more.
b. "Hand-Off-Automatic" switches in starter cover.
c. Interlocks, pneumatic switches and similar devices as required for coordination with the control requirement specified in Section 230900-Electronic Controls.
d. Built-in 120 volt control circuit transformer, fused from line side, where service exceeds 240 volts.

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1) Control circuit conductors to be protected in accord with the National Electrical Code.

e. Trip-free thermal overload relays, each phase.
f. Externally operated manual reset except on refrigeration compressors which shall have automatic reset. Automatic reset shall be limited to three attempts. If motor fails to start after three attempts, manual reset shall be required.
g. Undervoltage release or protection.
h. Phase failure/phase reversal protection on all legs.

F. Weather Protection: Provide weather-proof mounting of magnetic starters for equipment outside of the building.

2.3 ACCESS DOORS

A. Furnish access doors where shown on Drawings and at all locations where required for access to concealed valves, shock absorbers, dampers, cleanouts, control devices, humidifiers, filters, fans, and equipment servicing. See Architectural Specifications for door types. Deliver access doors to Construction Manager/General Contractor for installation and provide instructions for their location.

B. Exact location of access doors to be as directed by Mechanical Contractor and Architect.

OR

A. Furnish steel access doors, minimum size required for normal service use or as sized on drawings as manufactured by Inryco/Milcor, Walsh, where shown on mechanical or architectural drawings, and where required for access to valves, shock absorbers, dampers, mechanical equipment or appurtenances.

B. Standard Doors:

1. Frames: 16 ga. steel.
2. Panels: 14 ga. steel.
3. Finish: Chemically bonded prime coat of baked enamel.
4. Hinge: Concealed spring hinges openable to 175 degree; removable pins. Provide number of hinges as recommended by manufacturer for size of door.
5. Locking Devices: Flush steel, screwdriver operated, cam type locks. All access doors below 8'-0" in public areas shall be key-operated cylinder lock with two keys. Same key shall open all access doors.
6. Style of doors shall be appropriate for architectural finish at door location. Furnish masonry anchors where required.

C. Fire Rated Doors:

1. Frames: 16 ga. steel.
2. Panels: Sandwich type, 20 ga. steel sheets, manufacturer's standard insulated core.
3. Finish: Chemically bonded prime coat of baked enamel.
4. Hinge: Continuous type, steel with stainless steel pin.
5. Closer: Automatic closing mechanism.
6. Locking Devices: Self-latching, key-operated cylinder lock with two keys; interior, latch release mechanism.
7. Style of doors shall be appropriate for architectural finish at door location.
8. Fire rated doors shall have components and assemblies meeting requirements of the American Insurance Association, Factory Mutual Insurance Association and listed by Underwriters Laboratories, Inc.

D. Exact location of access doors shall be as directed by Mechanical Contractor and approved by the Architect.

E. Doors shall be installed by the General Contractor.

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2.4 VALVES

A. General:

1. Provide valves as specified herein and as indicated on the Drawings complete with accessories and attachments as required and appropriate for the pressure/temperature of system.
2. Supply valves for proper pressure ratings determined by the system working pressures at point of use and of proper types for systems and functions indicated.
3. Steam and Condensate System Isolation Valves: Use steam rated ball valves on pipe sizes 2” and smaller. Use gate valves on pipes larger than 2”. Use globe valves on manual bypass lines.
4. Provide like type valves of one manufacturer only unless specified otherwise.
5. Plainly and permanently mark valves with manufacturer's name or trademark, pressure rating, both Cold Working Pressure (CWP) and Steam Working Pressure (SWP), as applicable and flow direction when required to prevent improper installation.
6. Mark valves requiring approval by Underwriter's Laboratories (UL) or Factory Mutual Engineering Division (FM) with appropriate markings cast into the valve body.
7. Provide extended necks as appropriate for insulation.

B. Manufacturers:

1. The following manufacturers are acceptable providing the product to be considered is equivalent in every respect to the nomenclature provided by the specified make and model.

    a. Bronze Valves: Powell, Milwaukee, Red-White, Crane, Hammond, Nibco.
    b. Iron Body Valves: Powell, Milwaukee, Red-White, Traverse City, Kennedy, Mueller, Iowa, American, Nibco.
    c. U.L., F.M. Approved or Listed Valves: Nibco, Demco, Mueller, Pratt, Kennedy, Mission, Milwaukee, Hammond.
    d. Ball Valves: Hammond, Watts, Jamesbury, Worcester, Milwaukee, Apollo, Powell, Dynaquip, Nibco, Spirax Sarco, FNW.
    e. Butterfly Valves: Milwaukee, Hammond, Centerline, DeZurik, Fisher, Victaulic, Keystone, Posi-Seal, TEC, Flowseal, Nibco, IFC, FNW.
    f. Lubricated Plug Valves: Homestead, Nordstrom, Powell.
    g. Non-Lubricated Eccentric Plug Valves: DeZurik.
    h. Stop and Drain and Drain Valves: Milwaukee, Hammond, Red-White, Prier, Nibco or United Brass.
    i. Gas Cock: Peter Healy or Crane.
    j. Check Valves: Nibco, IFC, DFT.

C. Valve Schedule:

1. Standard Bronze Valves - 150 SWP/300 CWP, per ASTM B61/B62. No brass materials will be accepted.

    a. Check, Gate, and globe with union bonnet and rising stem.
    b. Sizes 1/8 through 2 inches.
    c. Schedule:

Plan Code:	G.V.	GL.V.	C.V.	L.C.V.
Valve Type:	Gate	Globe	Swing	Lift
Make:	Nibco	Nibco	Nibco	Crane
Straight Threaded:	T-134	T-235Y	T-433Y	365.5
Straight Soldered:	S-134	S-235Y	S-433Y	--

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Angle Threaded:	--	T-335Y	--	--
Angle Soldered:	--	--	--	--

2. Standard Bronze Valves - 300 SWP/600 CWP, per ASTM B61/B62, no brass materials will be accepted.

   a. Gate, globe and check.
   b. Sizes 1/8 through 2 inches.
   c. Schedule:

Plan Code	G.V.	GL.V.	C.V.	L.C.V.
Valve Type:	Gate	Globe	Swing	Lift
Make:	Nibco	Nibco	Nibco	Crane
Straight Threaded:	T-134	T-235Y	T-433Y	365.5
Straight Soldered:	S-134	S-235Y	S-433Y	--
Angle Threaded:	--	T-335Y	--	--
Angle Soldered:	--	--	--	--

3. Standard Iron Body Valves - 125 SWP/200 CWP.

   a. Gate, globe and check.
   b. Sizes 2-1/2 through 12 inches.
   c. Schedule:

Plan Code:	G.V.	OS&Y	GL.V.	C.V.	W.C.V.	N.S.C.V.
Valve Type:	Gate	Gate	Globe	Swing	Weighted	Non Slam
Make:	Nibco	Nibco	Nibco	Nibco	Nibco	Crane
Straight Threaded:	T-619	T-617-0	T-718B	T-918Y	T-918YBLW	--
Straight Flanged:	F-619	F-617-0	F-718B	F-918Y	F-918YBLW	23
Angle Threaded:	----	----	T-818B		----	----
Angle Threaded:	----	----	F-818B	----	----	----

4. Standard Iron Body Valves - 150 SWP/300 CWP.

   a. Gate, globe and check.
   b. Sizes 2 through 12 inches.
   c. Schedule:

Plan Code:	G.V.	OS&Y	GL.V.	C.V.	N.S.C.V.
Valve Type:	Gate	Gate	Globe	Swing	Non Slam
Make:	Nibco	Nibco	Nibco	Nibco	Crane (Chapman)
Straight Threaded:	T-669	T-667-0	--	--	--
Straight Flanged:	F-669	F-667-0	F-768B	F-968B	223
Angle Threaded:	--	--	--	--	--
Angle Flanged:	--	--	F-868B	--	

5. Standard Iron Body Valves - 250 SWP/500 CWP.

   a. Gate, globe and check.

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b. Sizes 2 through 12 inches.

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c. Schedule:

Plan Code:	G.V.	OS&Y	GL.V.	C.V.	N.S.C.V.
Valve Type:	Gate	Gate	Globe	Swing	Non Slam
Make:	Nibco	Nibco	Nibco	Nibco	Crane
Straight Threaded:	T-669	T-667-0	--	--	--
Straight Flanged:	F-669	F-667-0	F-768B	F-968B	223
Angle Threaded:	--	--	--	--	--
Angle Flanged:	--	--	F-868B	--	--

6. UL and FM Approved Valves.

   a. Gate, check and butterfly.
   b. Sizes all.
   c. Schedule:

Plan Code:	OS&Y	C.V.	W.V.C.	BF.V	D.V.
Valve Type:	Gate	Swing	Wafer	BTFY	Drain
Make:	Nibco	Nibco	Nibco	Demco	Nibco
Straight Threaded:	T-104-0	T-413W	--	--	T-211Y
Straight Flanged:	F-607-0	F-908-W	--	--	--
Wafer:	--	--	W-900-W	NE-H	--

7. UL and FM Approved Valves - 175 Pound Water.

   a. Post indicator with indicator post.
   b. Sizes 4 through 12 inches.
   c. Schedule:

Plan Code:	P.I.V.	P.I.V.B.F.
Valve Type:	Gate	BTFY
Make:	Nibco	Demco
Straight Flanged:	F-609	NE-H (Wafer)
Mechanical Joint:	M-609	--
Indicator Post Vertical:	NIP-1	Stem extension and gear operator with post indicator U.L. Listed only.
Indicator Post through Wall:	NIP-2	--

8. Underground Valves - 175 Pound Water, American Water Works Association (AWWA).

   a. Gate valves with service boxes.
   b. Sizes (see schedule).

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c. Schedule:

Plan Code:	GV & SB	GV & SB
Size/Inches:	3/4 thru 2	2 thru 16
Valve Type:	Oriseal	Gate
Make:	Mueller	Mueller
Model:	H-15201	A-2380-22 or 2380-18
Service Box:	H-10396-86	H-10357
Base:	H-10396-7-8-9 or H-10400	No. 6 Oval
Key:	Stationary rod attached.	A-24610 Furnish one each box.

9. Ball Valve:

a. Blowout proof stem.
b. Full port type with appropriate seals and seat, as specified.
c. Bronze bodies per ASTM B61/B62 or ASTM B-584. No brass material will be accepted.
d. Stainless steel bodies per ASTM A-351, Grade CF3M.
e. Schedule:

Plan Code:	B.V.	B.V.	H.V.	S.B.V.
Service:	Balancing	In line control and isolation	Refrigeration	Steam and Steam Condensate
Pressure:	150 SWP/300 CWP	150 SWP/300 CWP	500 CWP	150 SWP
Sizes/Inches:	1/4 thru 2-1/2	1/4 thru 3"	3/8" thru 2 1/8"	½” thru 2”
Make:	Nibco	Nibco	Nibco	Nibco
Straight Threaded:	T-580-70-66	T-585-70-66	--	T-595-Y-S6R-66
Straight Solder End:	S580-70	S585-70	S595-Y-66	--
Actuator:	Lever with memory stop	Lever	Lever	Lever
Port:	Standard	Full	Full	full

* Steam ball valve includes a three-piece body, seals rated for steam operating temperatures up to 400°F.

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10. Butterfly Valves:

a. Schedule; standard 150 psi with 150 psi ANSI companion flanges for use where system pressures cannot exceed 200 psig shut off (static) pressure.

Plan Code:	BFV		
Style:	Semi-lug wafer body		
Pressure Rating ANSI Class:	150 minimum		
Body:	Cast Iron		
Disc:	Aluminum Bronze		
Stem:	316 Stainless	18-8 Stainless	17-4 PH Stainless
Seat:	EPDM (-40 deg.F to 250 deg.F)		
Actuator:	2" thru 5" Infinite position lever with memory stop. 6" thru 24" Self-locking worm gear with adjustable limit stops, and position indicator. Provide chain wheel and chain where indicated by contract documents.		
Make:	Keystone		
Size:	2"-12"	14"-20"	24-36
Model:	228	122	AR1

b. Schedule: High performance 300 psi with 300 psi ANSI companion flanges for use where system pressures are more than 200 psig but cannot exceed 700 psig shut-off (static) pressure.

Plan Code:	BFV	
Style:	Lug	
Pressure Rating ANSI Class:	300 minimum	
Body:	Carbon steel ASTM A-216	
Disc:	316 stainless steel ASTM A-216	
Stem:	Stainless steel ASTM A564 Type 630 (17-4PH)	
Seat:	Virgin TFE	
Actuator:	3" and 4": Rachet handle with lock. 6 and over: Worm gear with lock.	
Make:	Flowseal (Mark Controls Corp.)	
Size:	3" and 4"	6" and over
Model:	XX-3L-121TTH-L	XX-3L-121TTH-2

11. Stop Check Valve:

a. Schedule:

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Plan Code:	S.C.V.
Pressure:	250 SWP/500 CWP
Size/Inches:	2-1/2 thru 10"
Make:	Crane
Straight Flanged:	28E
Angle Flanged:	30E

12. Eccentric Plug Valve:

    a. Schedule:

Plan Code:	E.P.V.	E.P.V.
Pressure:	175 lb. CWP	175 lb. CWP
Size/Inches:	1/2 thru 3	4 thru 8
Make:	DeZurik	DeZurik
Model:	400	100
Actuator:	483-487	159 w/Memory Stop
Ends:	Threaded	Flanged

13. Gas Valves:

    a. Gas cock and lubricated plug.
    b. Schedule:

Plan Code:	G.C.K.	L.P.V.	L.P.V.	G.B.V.
Pressure:	100 PSI Air	200 lb. CWP	200 lb. CWP	250 PSI LP-Gas
Size/Inches:	1/2 thru 1	1/2 thru 3	4 thru 12	1/4" thru 3"
Make:	Peter Healy	Walworth	Walworth	Apollo
Model:	1500-F	1700	1707-F	80-100
Actuator:	None	E-2	Wrench as required	1/4 turn
Ends:	Threaded	Threaded	Flanged	Threaded

14. Specialty Valves:

    a. Petcock, stop and drain, drain, needle.

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b. Schedule:

Plan Code:	PTK	S&D.V.	D.V.	N.V.
Type:	Petcock	Gate	Ball	Needle
Pressure:	250 LB.	125 LB.	125 LB.	200 LB.
Size/Inches:	1/8	1/2 and ¾	3/4	1/8 thru 3/4
Make:	Powell	Nibco	Apollo	Jenkins
Model:	922	76 or 726	78-104	743G
Ends:	Threaded	Threaded or Soldered	Threaded and Hose End Adaptor	Threaded

2.5 PIPE HANGERS, SUPPORTS, AND ACCESSORIES PROTECTION

A. General:

1. Provide hangers, rods, clamps, brackets, attachments, inserts, bracing, nuts, coach screws, eye bolts, clips, plates, and washers as required for appropriate installation for building structure provided.
2. All hangers and accessories shall be manufactured by one manufacturer for compatibility of all components.
3. All hangers, attachments, and accessories shall be provided with a certified manufacturers safety factor of five (5).
4. All hangers, attachments and accessories shall comply with the following:

   a. Safety factor of 5 (actual load vs. ultimate load).
   b. National Fire Protection Association (NFPA) (except as amended by provisions of this Specification for minimums) and as applicable.
   c. Factory Mutual Engineering Division (FM) as applicable.
   d. Manufacturers Standardization Society (MSS).

5. Support and positioning of piping shall be by means of engineered methods that comply with IAPMO PS 42-96.

B. Material:

1. Hangers in contact with steel, iron, cast or ductile iron shall be hot dipped galvanized or cold galvanized with "Galvilite by ZRC" cold galvanized compound only to a thickness of not less than 3.0 mil (.003 inches). "Galvilite by ZRC Worldwide, Marshfield, MA. Tel: (800) 831-3275, www.zrcworldwide.com" or equal.
2. Hangers in contact with copper piping shall be copper clad or provided with heavy density felt (20 oz.) pad permanently attached to the hanger and placed so as to prevent direct contact between pipe and hanger. Felt shall be mildew and moisture rot-proof. Heavy polyvinyl chloride coating on hanger, 5 mil thickness minimum will be acceptable in lieu of felt.
3. Hangers in contact with "plastic" or "glass" piping shall be galvanized in accordance with Sub-paragraph B-1, above and padded in accordance with Sub-paragraph B-2, above.
4. Hangers for insulated piping shall be sized to accommodate the insulation. Provide with insulation shields or insulation saddles* as applicable and appropriate and in accordance with the following schedule:

Nominal Pipe or Tubing Size	Shield Length	Shield Gauge Thickness	Material
½" thru 3"	12"	18	Galvanized

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Nominal Pipe or Tubing Size	Shield Length	Shield Gauge Thickness	Material
4"	12"	16	Galvanized
5"	15"	16	Galvanized
6"	18"	16	Galvanized
8"	24"	--	B-line (B3160-3165)
over 8"	36"	--	B-line (B3160-3165)

* Insulation inserts between piping and shield shall be furnished by 230700 Contractor for appropriate pipe size and insulation thickness for all insulated piping requiring a vapor barrier.

5. Provide swivel ring hangers similar and equivalent to B-Line B-3170, 3170CT, and 3170C for pipe sizes 1/2" thru 8".
6. Clevis type hangers may, at the Contractors option, be provided when similar and equivalent to B-Line B-3100, and 3100C.
7. Roller type hangers shall be used on all steam piping 4" and larger and when appropriate shall be equivalent to B-Line B-3110 black steel with cast iron roller. Provide insulation saddles for all roll-type hangers, B-Line B3160-3165. Calcium silicate inserts, in conjunction with insulation saddles shall be provided on all steam piping.
8. Beam and bar joist clamps shall be appropriate for attachment locations, top beam, bottom beam, etc., and provided with retainer rods, clips or straps as required.
9. Hanger spacing and minimum rod sizes shall be based on the applicable Mechanical and Plumbing Codes for the type of piping installed.
10. Riser clamps shall be provided on all vertical risers at each floor and shall conform to materials and protective coatings or pads as specified in Paragraph B of this Article 2.05. Clamps shall be similar and equivalent to B-Line B-3131 and B-3148.
11. Provide concrete inserts where required in flat slab construction similar and equivalent to B-Line B-22-1 Series 2000 lbs. per foot load capacity and spaced per hanger spacing schedule (sub-paragraph B-9 above) provide all accessories and nuts required.
12. Trapeze hangers shall be constructed of channel similar and equivalent to B-Line Series B-11 thru B-72 as appropriate complete with pipe clamps, nuts, rollers etc., as required. Channel to bear 5 times actual weight of all piping on trapeze system with minimum deflection. (.01 inch maximum). At a minimum, install pipe clamps on every other trapeze hanger, and where required to comply with seismic restraint design.
13. Wall brackets shall be fabricated "knee" brackets conforming to requirements of sub-paragraph B-12 above and made up with B-Line Series B-11 thru B-72 channel. Angle clips may be used in wood joist construction when similar and equivalent to B-Line B-3060 or 3061.
14. Hangers attached to wood construction shall be attached by use of eye bolts, coach screws or lag bolts when load bearing ratings maintain a safety factory of 5.
15. All other means of support i.e., special construction, pipe stands, earthquake bracing, sway bracing, etc., shall be provided as required and in conformance with jurisdictional authority and these Contract Documents, submit all special or required support and bracing systems for review by the Architect/Engineer prior to installing any item.
16. All vertical refrigeration suction and hot gas, and all steam piping shall be provided with insulation shields and calcium silicate inserts at each support location.
17. All piping systems exposed to motorized traffic shall be fully protected by installation of concrete-filled pipe bollards. Bollards shall be cleaned and painted as directed by the Architect.
18. For plenum applications use pipe supports that meet ASMT E-84 25/50 standards.

C. Acceptable Manufacturers:

1. Manufacturers acceptable to this Specification are as follows, all other manufacturers must submit for acceptance.

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a. B-Line
b. Fee & Mason
c. Grinnell
d. Hubbard Enterprises/HOLDRITE
e. P.H.D.
f. Michigan
g. Tolco
h. MAPA
i. Hilti

2.6 IDENTIFICATION MATERIALS FOR PIPING AND EQUIPMENT

A. Materials for identification shall be as follows:

1. Metal Tags: Round brass discs, minimum 1-1/2" diameter with edges ground smooth. Each tag shall be punched and provided with brass chains for installation.
2. Engraved Nameplates: Fabricate from plastic sheet stock of sufficient thickness to allow engraved lettering in contrasting color. Attach nameplates to equipment with screws.

3. Painted Stencils: Of size and color per ANSI A13.1 using clean cut letters and oil base paint. Paint material shall comply with Architectural Painting Specifications. See Part 3 for legend and size for Stencils.

***** OR *****

3. Pressure Sensitive Markers: Brady Type 350 flexible vinyl film identification markers and tape, with legend, size and color coding per ANSI A13.1. or approved equal.

***** OR *****

3. Semi-rigid Plastic Identification Pipe Markers: Section Setmark with legend, size and color coding per ANSI A13.1 Direction of flow arrows are to be included on each marker, unless otherwise specified.

a. Setmark Type Snap-Around markers to be used on diameters 3/4" thru 5".
b. Setmark Type Strap-Around markers to be used on diameters 6" or larger.

Insulation or Pipe Diameter	Length of Color Field	Size of Letters
3/4" 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"
Ductwork and Equipment	NA	2-1/2"

2.7 FREEZE PROTECTION SYSTEMS FOR PIPING AND EQUIPMENT (HEAT TRACING)

A. General:

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1. Provide freeze protection for all water, sewer, sumps, tanks, pumps, equipment drains, etc., where piping and equipment are subject to ambient temperatures of less than 35 deg.F, and as indicated on Contract Drawings.
2. Approved Manufacturers: Raychem, Thermon, Heat Trace Solutions.
3. Freeze protection shall consist of electrical self regulating semi-conductive "core" heat cable complete with all accessories including but not limited to an adjustable thermostat sensing the pipe or vessel contents temperature in lieu of ambient sensing, and contactors to enable power to the heat cable when temperature is below thermostat setpoint.
4. The self-regulating heater shall consist of two (2) 16 AWG tinned-copper bus wires embedded in parallel in a self-regulating polymer core that varies its power output to respond to temperature all along its length, allowing the heater to be crossed over itself without overheating, to be used directly on plastic pipe, and to be cut to length in the field. The heater shall be covered by a radiation cross-linked modified polyolefin dielectric jacket.

   (Optional: For installation on plastic piping, the heater shall be applied using aluminum tape (AT180). To provide a good ground path where none exists and to enhance the heater's ruggedness, the heater shall have an outer braid of tinned-copper and an outer jacket of modified polyolefin (-CR).

5. In order to provide energy conservation and to prevent overheating, the heater shall have a self-regulating factor of at least 90 percent. The self-regulation factor is defined as the percentage reduction, without thermostatic control, of the heater output going from 40°F pipe temperature operation to 150°F pipe temperature operation.
6. The heater shall operate online voltages of either 120 or 208-277 volts without the use of transformers.
7. Heater shall operate from a circuit breaker for each tracing circuit.
8. The heat tracing shall maintain minimum "contents" temperature of 40 deg.F at ambient temperature of -20 deg.F when enclosed within a minimum of 1" fiberglass insulation on piping and vessels and pumps, no insulation required on sumps, etc., unless otherwise indicated.
9. Installation:

   a. Apply the heater linearly on the pipe after piping has been successfully pressure tested. Secure the heater to piping with cable ties or fiberglass tape.
   b. Apply "electric traced" signs to the outside of the thermal insulation.

10. Tests:

    After installation and before and after installing the thermal insulation, subject to testing using a 2500 VDC megger. Minimum insulation resistance should be 20 to 1000 megaohms regardless of length.

B. Manufacturers:

1.	Manufacturer:	Raychem	Raychem	Raychem
2.	Product:	Chemelex	Chemelex	Chemelex
3.	Trade Name:	XL-Trace	XL-Trace	XL-Trace
4.	Pipe Size:	½”-3”	½” - 3”	4” & Larger
5.	Product No.:	5XL-1	5XL-2	8XL-2-CR
6.	Voltage:	120V	277V	277V
7.	Max Circuit Length:	270 Ft.	470 Ft.	350 Ft.
8.	Thermal Rating:	5 Watts/Ft.	5 Watts/Ft.	8 Watts/Ft.
9.	Connection:	RAYCLIC-PL	RAYCLIC-PL	RAYCLIC-PL
10.	Splice Kit & Tee Kit:	RAYCLIC-T	RAYCLIC-T	RAYCLIC-T
11.	End Seal Kit:	RAYCLIC-S	RAYCLIC-S	RAYCLIC-S
12.	Thermostat:	RAYCLIC-E	RAYCLIC-E	RAYCLIC-E

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13. Glass Cloth Adhesive Tape:	GT-66	GT-66	GT-66

C. Responsibilities:

1. Heat trace including all accessories shall be furnished as part of the Work included in Division 23. Installation of cable on pipe including splices, strapping and bulb placement shall be by Division 23 Contractor.
2. Installation of power wiring including breakers and mounting thermostat enclosure shall be part of the Work included in Division 26.
3. Work under Division 23 includes coordination of material quantity and delivery, tracing installation, and insulation of piping after heat trace has been installed, inspected and tested.

2.8 DOMESTIC HOT WATER HEAT MAINTENANCE SYSTEM

A. General:

1. Provide electrical heat maintenance systems for hot water supply lines, mains and branches as indicated on Contract Drawings.
2. Approved Manufacturers: Raychem, Thermon.
3. Furnish and install a UL Listed system of electric self-regulating heating cable and components for maintaining the water temperature in the hot water lines as indicated on the drawings. The cable shall utilize a radiation-crosslinked conductive polymer as the heating element, and the cable shall be specifically designed, manufactured, and U.L. Listed for domestic hot water temperature maintenance.
4. Heat maintenance strip shall consist of a flat flexible low heat density electric heater strip of parallel circuit construction, continuous inner core of self regulating conductive polymer material. Core shall be insulated with polyolefin jacket and a flexible braided nickel alloy shield jacket. Heater strip shall be capable of being cut to desired length in the field. Product to be U.L. Listed for this application.
5. Construction: The self-regulating heating cable shall consist of two (2) 16-AWG (1.2 mm^2) nickel-coated copper bus wires embedded in a radiation-crosslinked semiconductive polymer core. It shall be covered by a radiation-crosslinked, polyolefin, dielectric jacket surrounded by a polymer-coated aluminum wrap, and enclosed in a tinned copper braid of 14 AWG (2.5 mm^2) equivalent wire size. The braid shall be covered with a (nominal) 40-mil (1-mm) polyolefin outer jacket, color coded for easy identification
6. The self regulating heater shall respond to varying localized temperature conditions along the pipe by self regulating its heat output at each point along its length without reliance on thermostat control. Constant wattage heater systems <u>will</u> <u>not</u> be accepted.
7. Heater shall operate on 208V power single phase. Power shall be routed thru a circuit breaker for each heater circuit.
8. Heater strips shall be run in parallel with the pipe unless otherwise indicated on plans.
9. Heater shall have written 10 year manufacturer's warranty.

B. Manufacturers:

Manufacturer:	Raychem			
Product:	Chemelex			
Trade Name:	HWAT-PLUS			
Plan Code:	HWAT-1	HWAT-2	HWAT-3	HWAT-4
Product No.:	HWAT-B2	HWAT-G2	HWAT-Y2	HWAT-R2
Temperature Rating:	105°F	115°F	125°F	140°F
Voltage:	208V/1ph	208V/1ph	280V/1ph	208V/1ph
Max Circuit Length: 30 amp breaker	800 ft.	800 ft.	800 ft.	500 ft.
20 amp breaker	800 ft.	700 ft.	500 ft.	330 ft.
15 amp breaker	800 ft.	520 ft.	350 ft.	250 ft.
Power Connection Kit:	RAYCLIC-PL	RAYCLIC-PL	RAYCLIC-PL	RAYCLIC-PL
Splice/Tee Kit:	RAYCLIC-S, RAYCLIC-T	RAYCLIC-S, RAYCLIC-T	RAYCLIC-S, RAYCLIC-T	RAYCLIC-S, RAYCLIC-T

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End Seal Kit:	RAYCLIC-E	RAYCLIC-E	RAYCLIC-E	RAYCLIC-E
Glass Cloth Adhesive Tape:	GT-66	GT-66	GT-66	GT-66
Pipe Labels:	ETL	ETL	ETL	ETL

C. Responsibilities:

1. Heater cable including all accessories shall be furnished as part of the Mechanical Contract. Installation of cable on pipe including splices and strapping shall be by Division 23 Contractor.
2. Installation of power wiring, circuit breakers, mounting of breakers and conduit to point of HWAT start shall be included in Division 26 Contract.
3. Mechanical Contractor shall be responsible to coordinate material delivery, installation of heater cable, and insulation of piping after heater cable (HWAT) has been installed, inspected, and tested.
4. Heater manufacturer's representative shall be on-site to coordinate installation with electrical and mechanical contractors. Heater supplier to perform 2500 VDC megohmeter test to measure continuity and insulation resistance between bus wires and braid. Megger reading to be a minimum of 20 megohms regardless of heater length. These tests to be performed prior to and after pipe insulation has been installed and prior to wall or ceiling installation.

2.9 DIELECTRIC PIPE FITTINGS AND ISOLATORS

A. Manufacturer: Epco Sales Inc., Victaulic.

B. Schedule: (complete unions)

Model:	FX	GX
Sizes:	½" thru 2"	2" thru 12"
Maximum Pressure:	250 psi	175 psi
Maximum Temp.:	210 deg. F	210 deg. F
Epconite Gasket:	#2	#2
Ends:	FPT x Solder	FPT x Solder
Type:	Union	Flanged Union

C. Schedule: (companion flanges)

Model:	X	W	H
Sizes:	1-1/2" - 10"	1-1/2" - 12"	1-1/2" - 12"
Maximum Pressure:	175 psi	175 psi	175 psi
Maximum Temp.:	210 deg. F	210 deg. F	210 deg. F
Epconite Isolators:	#2	#2	#2
End Style:	Solder (Brass)	Weld neck	Iron Pipe Thread
Type:	Companion	Companion	Companion

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Face Gasket:	Same as Isolators		

D. Dielectric fittings shall conform to ASA B16.8, and shall be plated as applicable a minimum of .0005" and have no flow restriction when assembled.

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2.10 SOLVENTS FOR PLASTIC PIPING

A. Solvents for plastic piping joints shall be certified to meet SCAQMD Rule 1168/316A. This includes but is not limited to PVC, CPVC, and ABS piping, all grades and sizes.

2.11 EQUIPMENT DRAINS AND OVERFLOWS

A. Steel Pipe: ASTM A53, Schedule 40 galvanized.

1. Fittings: Galvanized cast iron, or ANSI/ASTM B16.3 malleable iron.
   Joints: Screwed or grooved mechanical couplings.

B. Copper Tubing: ASTM B88, Type M, hard drawn.

1. Fittings: ANSI/ASME B16.23 cast brass, or ANSI/ASME B16.29 solder wrought copper.
2. Joints: ASTM B32, solder, Grade 95TA.

C. PVC Pipe: ASTM D1785, Schedule 40.

1. Fittings: ASTM D2466 or D2467, PVC.
2. Joints: ASTM D2855, solvent weld.

D. ABS Pipe: ASTM D2680 or D2751.

1. Fittings: ASTM D2751.
2. Joints: ASTM D2235, solvent weld.

PART 3 - EXECUTION

3.1 GENERAL INSTALLATION

A. General: Unless otherwise specifically indicated on Drawings or in Specifications, install equipment and materials in accordance with recommendations of manufacturer, including performance of tests as manufacturer recommends.

B. Protection:

1. Close ends of pipe and ductwork during construction and cover equipment to prevent entry of foreign material. Protect insulation against dirt, water, chemical or mechanical damage before, during and after installation. Cover floor drains and protect fixtures and equipment against damage during concrete pours and mechanical work.

C. Quiet Operation and Vibration:

1. All work shall operate in accordance with Section 230540 - Mechanical Sound and Vibration Control under all conditions of load.
2. Sound or vibration conditions not in accordance with Section 230540 and considered objectionable shall be corrected in a manner approved by the Architect under the Work of Division 23.

3.2 WELDING

A. Joints between sections of pipe, between pipe and fittings, shall be fusion welded. Use only certified welders. Strength of finished welded joints to be equal to strength of pipe. Width of finished weld to be at least 2-1/2 times the thickness of the part joined. Thickness of weld to be at

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least 25% greater than the thickness of pipe or fittings. Finished welded joints to present neat and workmanlike appearance.

B. Make no direct welded connections to valves, strainers, apparatus, and related equipment. Make connections to flanged valves, and flanged equipment with welded pipe connection flanges.

C. Radii of weld ells to be 1-1/2 times nominal diameter of fittings. Fittings used for all branch connections, whether full-size or reducing, to have interior surfaces smoothly contoured. Wall thickness of welded fittings equal to adjacent piping.

3.3 ELECTRIC WIRING

A. Furnish equipment requiring electrical connections to operate properly and to deliver full capacity at electrical service available.

B. All control wiring to be in accordance with manufacturer's recommendations; all wiring shall be color coded to facilitate checking.

C. Unless otherwise indicated, all mechanical equipment motors, starters, and controls shall be furnished, set in place, and wired in accordance with the Electrical Equipment/Wiring Responsibility Matrix on the drawings. Contractor should note that the intent of this electric wiring matrix is to have the Division 23 Contractor responsible for coordinating all control wiring as outlined, whether or not specifically called for by the mechanical or electrical drawings and specifications. Mechanical Contractor shall comply with the applicable requirements of Division 26 for electrical work of this Division 23 which is not otherwise specified. No extras will be allowed for Contractor's failure to provide for these required items. The Division 23 Contractor shall also refer to the Division 26 specifications and plans for all power and control wiring and shall advise the Architect/Engineer of any discrepancies prior to bidding.

ELECTRICAL EQUIPMENT/WIRING RESPONSIBILITY MATRIX

Item	Furnished By*	Set By*	Power Wiring*	Control Wiring*
Equipment Motors	MC	MC	EC	MC
Motor Starters & Overload Heaters	MC – Except when shown on MCC	EC	EC	MC
Fused & Unfused Disconnect Switches, Thermal Overload & Heaters	EC	EC	EC	--
Manual Switches & Speed Control Switches carrying full load currents.	MC	EC	EC	EC
Fire/Smoke and Smoke Dampers	MC	MC	EC – Requires emergency power circuit if air system served is on emergency power.	EC
Control Relays & Transformer (See Note 2)	MC	MC	EC	MC
Thermostats (Line Voltage)	MC	EC	EC	EC
Temperature Control Panels	MC	MC	EC	MC
Building Fire Alarm System Fire & Smoke Detectors, including Relays in Starters for Fan Shutdown.	EC	EC	EC	EC
DDC Interface to Fire Alarm System	MC	MC	EC	MC

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Item	Furnished By*	Set By*	Power Wiring*	Control Wiring*
Electric Plumbing Fixtures, Sensor Faucets, Sensor Flush Valves, Electric Water Coolers, and required Transformers.	MC	MC	EC	MC
Motor & Solenoid Valves, Damper Motors, PE & EP Switches, Control Valves, Low Voltage Thermostats	MC	MC	MC	MC
Pushbutton Stations & Pilot Lights (manually operated switches not carrying load currents).	MC	MC	N/A	MC
Pushbutton Stations & Pilot Lights carrying fully load current.	MC	EC	EC	N/A
Exhaust fans for kitchen hoods or fume hoods where interlocked with make-up air fans.	MC	MC	EC	EC
Exhaust fans when switched with room lights.	MC	MC	EC	EC
Fire sprinkler system alarms, tamper switches, flow switches and fire alarm systems tie-ins to provide a complete fire protection system.	FPC	FPC	FPC	FPC
Temporary Heating Connections	MC	MC	EC	MC
Freeze Protection Heat Cable	MC	MC	EC	MC
Heat Maintenance Cable	MC	MC	EC	--
HVAC Water Treatment Interlocks and Glycol Pumps	MC	MC	EC	MC
Fire/Smoke Dampers for all air sources to FM-200 Protected Area 120VAC (Energize Open)	MC	MC	EC – Requires emergency power circuit	EC
FM-200 System Wiring-Panel, Detectors and Local Alarms & Lights	FM	FM	EC – Requires emergency power circuit	FM
Contacts for P.D.U. for Power Shutdown to Equipment in FM-200 Protected Areas	FM	FM	EC	EC
Contacts in FM-200 Panel for Building and Central Station Fire Alarm	FM	FM	EC	EC
Cooling Tower Level Control and Fan Vibration Switch	MC	MC	MC	MC
Cooling Tower Sump Heaters	MC	MC	EC	MC

* MC = Mechanical Contractor under Division 23 of the work.
* FM = Mechanical Contractor under Section 212200 - FM-200 Fire Suppression System.
* FPC = Fire Protection Contractor.
* EC = Electrical Contractor under Division 26 of the work.
* MGES = Medical Gas Equipment Supplier (Section 226313).

D. All temperature control conduit and wiring shall be furnished and installed under Section 230900. All motorized damper and motorized valve wiring shall be furnished and installed under Section 230900.

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3.4 SLEEVES, PLATES AND CLOSURES

A. Division 23 Contractor shall provide and locate pipe sleeves, and inserts required before new floors and walls are built or shall be responsible for the cost of cutting and patching required where sleeves and inserts were not installed or where incorrectly located.

B. Provide sleeves for mechanical piping passing through concrete floor slabs and through concrete, masonry, tile, and gypsum wall construction. Provide metal collars to close and protect openings.

C. Where sleeves are placed in exterior walls below grade, pack spaces between the pipe or conduit and the sleeves with Hornflex Thiokol L-32 Sealant or Link Seal and make water-tight. Provide metal rodent collars securely fastened to structure.

D. Where pipe motion due to expansion and contraction will occur, make sleeves of sufficient diameter to permit free movement of pipe. Where sleeves pass insulated pipes, the sleeves shall be large enough to pass the pipe only and the insulation shall be made to butt against the construction, except for pipes requiring insulation having a vapor barrier, in which case, the sleeves shall be large enough to pass the pipe and insulation. Check floor and wall construction finishes to determine proper length of sleeves for various locations, make actual lengths to suit the following:

1. Terminate sleeves flush with floors, walls, partitions, and ceilings.
2. Seal annular space around pipes watertight at floor penetrations.
3. In areas where pipes are concealed, as in chases, terminate sleeves flush with floor.
4. In all areas where pipes are exposed, extend sleeves 1/4" above finished floor, except in rooms having floor drains, where sleeves shall be extended 2" above floor and in Kitchens and Mechanical Equipment Rooms, where sleeves shall be extended 4" above floor.

E. Sleeves shall be constructed of 24 gauge galvanized sheet steel with lock seam joints for all sleeves set in concrete floor slabs terminating flush with the floor. All other sleeves shall be constructed of galvanized steel pipe unless otherwise indicated on the drawings. "Crete Sleeve" (plastic type) sleeves are acceptable for concrete construction as manufactured by Sperzel Division, Shamrock Industries or Willoughby Industries.

F. Fasten sleeves securely in floors and walls so that they will not become displaced when concrete is placed or when other construction is built around them.

G. Provide tight fitting floor and ceiling plates on pipes passing thru walls, ceilings, and floors. Nickel or chrome plated in finished areas, galvanized cast iron in unfinished areas. Provide wall and ceiling flanges for ducts in finished areas.

H. Provide all cutting, patching of holes, openings, notches. Obtain written approval for notching, boring, chipping, burning, drilling, welding to structural members in accordance with the General Conditions of the Contract and paragraph 3.7 of this Section.

I. Where pipe sleeves penetrate fire rated walls and floors, this contractor shall use fire safing to seal openings.

3.5 FOUNDATIONS, PADS AND CURBS

A. Concrete foundations, pads and curbs for work under Division 23 shall be provided by the General Contractor. This requires the Division 23 Contractor to coordinate all necessary pads and curbs with the General Contractor before bid date. Failure to do so results in these items becoming the responsibility of the Division 23 Contractor.

B. All dimensions and exact locations for anchor bolts, foundations, pads and concrete curbs for mechanical equipment in Division 23 shall be determined and located by the Division 23 Contractor.

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A. Provide dowels, anchor bolts, groutings, concrete foundations and pads for pumps, plumbing, heating and ventilating or air conditioning equipment in accordance with Concrete Specifications.

B. Dimensions and exact locations for foundations and concrete curbs for mechanical equipment to be field verified and located accurately by Division 23 Contractor.

C. When water heaters and similar equipment are installed in a suspended application, an engineered and manufactured platform shall be used. Weight loading capability shall include a minimum safety factor of 2.

3.6 EXCAVATING AND BACKFILLING

A. Excavate for all mechanical equipment such as fuel tanks, ductwork, sump pumps, manholes and trenches for underground pipelines to required depths. Compact bottoms of excavations. Slope to obtain required grade. Remove rocks, trash and debris before installation of equipment and backfilling. Backfill by hand tamping earth under the haunch of the pipe to specified compaction. Backfill and compact in thin layers until top of pipe is covered. Complete backfill by methods required or directed for soil characteristics to comply with the Architectural section of these specifications.

B. Excavations near footings shall be such that, when nearing building footings, or bearing foundation walls, the excavation bottom shall not be nearer the footing than a normal 45 degree bearing line from edge of footing bottom to bottom of excavation. When it is necessary to perpendicularly cross under a continuous foundation wall, care shall be taken to ensure that crossing is clear of the structural foundation and of minimal width.

C. Do not place backfill over pipelines until lines are properly tested.

D. When trenching through specially tested areas, such as paving, asphalt, etc., Contractor shall be responsible for restoring the surface to its original condition, and in a manner approved by the Architect. Repair trenches where settlement occurs and restore the surface for the period of one year after final acceptance of the project. All cutting of paving, asphalt, etc. shall be by saw cutting.

3.7 CUTTING AND PATCHING

A. Openings in New Construction:

1. Provisions for New Openings: The Division 23 Contractor shall verify all openings required in the new construction in connection with the work under Division 23 with the Architectural and Structural Drawings and shall then meet with and verify same with the General Contractor/Construction Manager who will assign the work to the appropriate contractor to provide all openings in the new construction of the correct size and location in walls, floors or through roofs required for the installation of the mechanical work.

B. Cutting in New Construction:

1. Failure on the part of the Division 23 Contractor to make the above arrangements for required openings shall cause the cost of cutting and patching for the necessary openings for the installation of his work to be borne by him, either by being assigned to the General Contractor/Construction Manager or in the form of performing the required cutting himself. In either case, all patching shall be done by the appropriate finishing contractor as determined by the General Contractor/Construction Manager. No cutting or drilling of holes shall be done without approval of the Architect/Engineer.

C. Patching in New Construction:

1. The appropriate finishing contractor as determined by the General Contractor/Construction Manager shall patch all openings in the new structure. All openings made in fire rated walls, floors, or ceilings, shall be patched and made tight to conform to the fire rating for the enclosure. All materials used in patching shall match the

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materials specified in the Architectural Specifications and all patched areas shall be restored to the specified finish surface to the satisfaction of the Architect.

2. The Division 23 Contractor shall pay the appropriate Finishing Contractor as determined by the General Contractor/Construction Manager for all patching resulting from cutting to accommodate mechanical work.

D. Cutting in Existing Building:

1. The Construction Manager/General Contractor shall make arrangements for required openings in the existing building to facilitate the passage of ductwork, piping, etc. thru existing floors, walls, and beams. Division 23 Contractor to coordinate all requirements.

E. Patching in Existing Building:

1. The General Contractor shall patch all existing walls and floors to match existing.

3.8 PIPE HANGERS/SUPPORTS

A. Use inserts, anchors, expansion bolts or other approved and acceptable means of attachment to concrete construction. Set inserts in advance of concrete installation, provide required reinforcement rod for all inserts carrying loading equivalent of one 4" pipe or more. All inserts shall be flush with face of slab or wall containing insert.

B. Provide flat square washers for rods thru metal decking with nut above washer, when acceptable and approved.

C. Cinch hangers to carry appropriate share of loading and slope piping without sags or "pocketing" as appropriate and required.

D. Rod offsets, or angle installation, plumber tape or wire will not be accepted. Hanger rods shall be true and plumb.

E. Piping shall not be hung from other piping or equipment items. Provide attachments to building structure only. Use trapeze, wall brackets, knee brackets, etc., where hanger rods cannot be attached within spacing plumb to structures.

F. Provide sway and earthquake bracing where required in accordance with Section 230548 - Mechanical Seismic Control.

3.9 INSTALLATION OF VALVES

A. General:

1. Provide valves as shown on Contract Documents and as required for pressure relief, balancing and/or control of flow.
2. Provide isolation valves for maintenance and service on each piece of equipment regardless of whether or not shown on Contract Drawings.
3. Provide isolation valves for all branch line take-offs that serve more than two items of fixtures or equipment.
4. Provide balancing valves for each leg of domestic hot water return piping of two branches or more, all heating/cooling water returns and/or supplies to equipment as shown on Contract Documents.
5. Provide access means for each valve or group of valves either by access panels or utilization of inherent access provided by building methods i.e., lift out ceiling construction or exposed valve installations in non critical areas such as janitors closets, storage rooms, etc.

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6. Install all valves with valve bonnets or operating stems in vertical (upright) position when possible, valves may be installed with bonnets or stems not less than 35 degrees downward from vertical plane except valves on vertical piping may be 90 degrees from vertical plane. Swing type check valves shall be installed on horizontal piping no more than 45 degrees upward slope from horizontal plane, using lift checks on vertical piping. Lift check valves shall not be used on sewage or sump pump discharge piping.
7. Inspect and tighten all bonnet nuts, bolts, packing glands, lubricate all valves requiring lubrication, secure all hand wheels and identification plates, be responsible for all valves having manufacturers name, trade name, working pressure and size stamped or cast into the body of the valve. Perform all maintenance, repacking and inspection prior to installation of valve.

B. Proper Installation of Valves:

1. Provide valves in accordance with the following schedule unless specified otherwise in Contract Documents.

   a. Dead-end shut off: Gate, ball, butterfly, plug, stop and drain.
   b. Throttling: Ball, plug, globe, diaphragm, needle, butterfly (when using butterfly valves for throttling, additional valves must be provided for service shutoff.)
   c. Backflow prevention: Check.
   d. Water hammer prevention: Silent or pilot operated non slam check.
   e. Gas piping: Lubricated plug (or ground joint cock up to 1" only), or UL-Listed ball valve.

C. Removal and Repair Provisions:

1. Provide all valves which are not accessible for repair without removal from piping with union connection immediately adjacent to valve outlet.

3.10 PAINTING

A. Surfaces of exposed equipment and materials to be thoroughly cleaned and left ready for painting in accordance with Architectural Painting Specifications, colors shall be coordinated with the architect.

B. All exposed ductwork to be provided with paintlock material.

C. Duct interiors visible through registers, grilles and diffusers shall be painted flat black.

D. Exposed gas piping to be cleaned, primed and painted 2 coats (grey).

E. All other painting of mechanical equipment and piping, unless otherwise noted, shall be performed under other divisions of the work with the exception of identification of piping and equipment which will be the responsibility of the Division 23 Contractor.

3.11 IDENTIFICATION OF PIPING AND EQUIPMENT

A. General: Provide pipe identification, valve tags, stencils, or engraved nameplates to clearly identify the mechanical equipment, piping and controls of the various mechanical systems and direction of flow in piping.

B. Methods for identification shall be as follows:

1. Metal Tags: Stamp tags with letter prefixes to indicate service, followed by a number for location in system.
2. Engraved Nameplates: Attach nameplates with brass screws. Pressure-sensitive embossed labels are not acceptable. Nameplates shall bear the same identifying legend used on the Contract Documents.

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3. Painted Stencils: Stenciled markings shall be neatly performed with no overspray, drips, or other imperfections. Pipes and equipment to be stenciled shall first be wiped clean of dirt, dust, rust, grease and moisture. Pipes and smooth, hard surface in the area the stencil is to be applied. Paint application shall comply with Architectural Painting Specifications.
   Size of Legend and Letters for Stencils:

Insulation or Pipe Diameter	Length of Color Field	Size of Letters
¾" 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"
Ductwork and Equipment	NA	2-1/2"

4. Piping Legend and Color (Contractor shall obtain written approval of colors from Owner's representative prior to starting work.)

Legend	Background Color	Direction Arrow	Pressure
Steam	Yellow	Arrow	PSI
Condensate	Yellow	Arrow	PSI
Feed Water	Yellow		
Chilled Water	Light Green	Arrow	
Tower Water	Light Green	Arrow	
Compressed Air	Light Blue		PSI
Medical Air	Black		PSI
Blow Down	Yellow		
Domestic Cold Water	Light Green		
Domestic Hot Water	Yellow		
Sprinkler-Fire	Red		
Fuel Oil	Light Brown	Arrow	
Natural Gas	Orange		
Nitrous Oxide	Dark Blue		
Oxygen	Green		
Medical Vacuum	White		
Heating Water	Yellow	Arrow	

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Legend	Background Color	Direction Arrow	Pressure
Solar Heated Water	Yellow	Arrow	
Refrigerant Liquid	Yellow	Arrow	
Refrigerant Suction	Yellow	Arrow	
Refrigerant Hot Gas	Yellow	Arrow	

5. Pressure Sensitive Markers: Apply pressure sensitive markers in accordance with manufacturer's recommendations with complete wrap around may be used at Contractor's option. Marker adhesion will be tested for permanence. Any markers showing dog ears, bubbles, or other failings shall be replaced.
6. Semi-Rigid Plastic Identification Markers: Seton Setmark premolded (not pressure sensitive) identification markers may be used at Contractor's option on service piping which is accessible for maintenance operations (but not on piping in finished spaces). This type marker shall not be installed on bare pipe when surface temperature exceeds 180 deg.F unless a 1" thick insulation band is first provided under marker for protection from the hot pipe.

C. Identification of Piping: Identify all piping accessible for maintenance according to the following procedures:

1. Use an arrow marker for each pipe-content legend. The arrow shall always point away from the pipe legend and in the direction of flow: color and height of arrow to be same as content legend lettering.
2. If flow can be in both directions, use a double-headed arrow indication.
3. Apply pipe legend and arrow indication at every point of pipe entry or exit where line goes thru wall or ceiling cut.
4. Apply pipe legend and arrow indication within 3" of each valve to show proper identification of pipe contents and direction of flow.
5. The legend shall be applied to the pipe so that lettering is in the most legible position. For overhead piping, apply legend on the lower half of the pipe where view is unobstructed, so that legend can be read at a glance from floor level.
6. For pipes under 3/4" O.D., fasten brass tags securely at specified legend locations.
7. Legend on steam piping, condensate return, compressed air, medical air, gas, and vacuum systems shall include working pressure or vacuum.
8. Insulated piping equipped with electric heat trace shall additionally be labeled “Electric Traced” with label of same size and color as the pipe legend.

D. Valves: All valves, including but not limited to domestic hot and cold water, hot water recirculation, heating water, chilled water, condenser water, steam, steam condensate return, fire protection, gas, medical gas, vacuum and special service valves located inside the building, shall be tagged and identified as to type of service, location number, and normal valve position (normally open or normally closed).

E. Controls: All magnetic starters and relays, shall have nameplates or be stenciled to identify connecting or controlled equipment. All manual operating switches, fused disconnect switches and thermal over-load switches which have not been specified as furnished with indexed faceplates shall also have nameplates or be stenciled as to "connected" or "controlled" equipment. All automatic controls, control panels, zone valves, pressure electric, electric pressure switches, relays, and starters shall be clearly identified.

F. Pumps: All pumps shall be identified as to service and zones served. Base mounted pumps shall be stenciled or have system served nameplates. Brass tags secured by brass chains may be used on small in-line pumps.

G. Storage Tanks, Water Treatment Equipment and Heaters: All tanks and heaters shall be stenciled as to service. The connecting pipes to each shall be identified and the service temperature entering and leaving the tank or heater shall be indicated.

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H. Fans: All supply and exhaust fans and air handling units and connecting ductwork supplying one or more areas from an equipment room or isolated crawl or furred space shall have nameplate or be stenciled as to plan code number, service and areas of zones served.

I. Air Conditioning Equipment: Air conditioning equipment such as chillers, pumps, condensers, or roof-top equipment shall be identified by stencils, or system nameplates.

J. Access Doors: Provide engraved nameplates or painted stencils to identify concealed valves, controls, dampers or other similar concealed mechanical equipment. Obtain Architect approval before installation on all access doors in finished areas.

K. Lift Out Ceilings: Provide engraved nameplates or black lettering on transparent adhesive labels on ceiling tee stem to identify concealed valves, controls dampers or similar concealed mechanical equipment which is directly above nameplate in ceiling space. Obtain Architect approval before installation.

L. Expansion tanks shall be labeled to indicate system served and precharge pressure.

M. Access Flooring: Provide thin engraved nameplate on access panel to indicate location of underfloor fan coils and smoke/fire dampers.

3.12 DRIP PANS

A. Provide drip pans under all fluid conducting piping which runs over servers, telecom equipment, electric switchgear, busway, or electric motor starters, and under all point-of-use water heaters.

B. Pans: 18 gauge galvanized iron. Pans shall be two inch deep, with rolled top edges, and shall extend six inches each side of the pipe or group of pipes and six inches beyond the equipment below. Keep pans as close to the underside of the pipes as practicable. All seams shall be soldered, and pans shall be crossbraced as required to prevent sagging and warping.

C. Pitch each pan to a drain connection, and pipe a 1-1/2 inch or larger copper tube drain to discharge over nearest available open drain.

D. Provide a drip pan under all coils that may have condensate during operation like heat recovery coils, etc. Pipe drain to nearest drain.

3.13 FIRE SAFING

A. Mechanical Contractor shall provide fire safing for his work as follows: Where fire rated separations are penetrated by pipes, conduit or ductwork, the annular space around the pipe, conduit or ductwork shall be filled with a U.L. Rated fire safing material. Refer to Division 7 for materials and application specifications.

3.14 HEAT MAINTENANCE CABLE AND FREEZE PROTECTION CABLE

A. Comply with National Electric Code Section 427 for installation.

B. Protect heater strips from damage before, during and after installation.

C. Provide waterproof insulation for all heat traced and heat maintained piping one inch thick minimum in accordance with Section 230700.

D. When installing <u>do</u> <u>not</u> twist buss wires together.

E. Test each circuit prior to and immediately after installation of thermal insulation using a megger under 500 volts D.C. Minimum insulation resistance reading shall be ten (10) megohms regardless

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of length, if less than ten (10) megohms investigate cause and replace damaged sections - do not repair!

F. Install heat cable on lower quadrant of pipe 45 degrees up from vertical, provide ties or fiberglass tape 12" on center max.

G. Install all accessories and kits per manufacturers' recommendations and standards. Careful attention to manufacturers' installation instructions as pertains to valves and equipment will be strictly adhered to and enforced.

3.15 DIELECTRIC PIPE FITTINGS AND ISOLATORS

A. Provide dielectric pipe fittings and isolators at all connections between dissimilar metals in the domestic water, and fire protection systems to control corrosion potential caused by galvanic or electrolytic action.

B. Typical locations for dielectric isolation are; water heaters, storage and pressure tanks, water conditioning equipment, pumps, changes in service piping materials, make-up connections to boilers and chilled water systems, valves, deaerators, flexible connectors and the like where materials of different electrode potential are joined.

C. Hangers for piping shall be isolated per Section 230529 when hanger and piping materials are dissimilar and subject to production of electrolysis or galvanic action.

D. Storage tanks shall be isolated from piping and tank stands by use of anti-electrolytic and galvanic isolators.

3.16 DRAIN LINES

A. Provide condensate drain lines from each cooling coil and evaporative media sump drain pan to nearest drain or to termination indicated.

B. Do not route condensate lines above electrical panels, switch gear, transformers, motor starters, elevator equipment, servers, or telecom equipment. Should there be a conflict with the plans and this paragraph, notify the Engineer immediately for corrective instruction prior to starting work.

3.17 HEATING SYSTEM USED FOR TEMPORARY HEAT DURING CONSTRUCTION

A. Permanent heating system shall not be used until building is totally and permanently enclosed (no temporary barriers for weather protection), and source of heat supply is permanently installed.

B. Once the heating system has been placed into operation, it shall not be shut down except for moderate weather, and all heated areas shall be maintained at a minimum temperature of 50 deg. F 24 hours a day.

C. When any air-handling equipment is used for temporary heat, the filters (MERV 13) shall be installed and maintained. Before building acceptance by Owner, these units shall be thoroughly cleaned, and new filters shall be installed. This is over and above the extra set of filters to be provided the Owner as called for in the specifications. Coils shall be cleaned if necessary, as determined by the Engineer. If project is LEED, provide additional MERV 8 filter over all return air grilles to prevent debris from entering. Tape around perimeter edge to seal to grille.

D. Any and all systems being used for temporary heat shall become the Contractor's responsibility to maintain and be put into first class working order before acceptance by the Owner.

E. Any manufacturer's guarantees that start with the use of equipment for temporary heat shall be extended by the contracting firm holding the prime contract for construction, so that the Owner will have his one-year guarantee from date of acceptance.

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END OF SECTION 23 05 29

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SECTION 23 05 40 - MECHANICAL SOUND AND VIBRATION CONTROL

PART 1 - GENERAL

1.1 RELATED WORK

A. Requirements: Provide Mechanical Sound and Vibration Control in accordance with the Contract Documents.

B. Related work specified in other Sections:

Section 230500 - Basic Mechanical Requirements
Section 230529 - Basic Mechanical Materials and Methods
Section 232113 - HVAC Piping & Specialties
Section 233300 - Ductwork and Accessories - Flexible Ductwork Connections

1.2 SYSTEM DESCRIPTION

A. The work includes, but is not limited to the following:

1. Support isolation for motor/driven mechanical equipment.
2. Rails or beams for distribution of equipment loading to isolation units.
3. Fabricated bases for distribution of equipment loading to isolation units.
4. Inertia base frames in conjunction with equipment isolation.
5. Isolation of pipes and ductwork.
6. Sound attenuating units.
7. Sound-linings.
8. Sound proofing of construction.
9. External sound proofing.

1.3 QUALITY ASSURANCE

A. The Division 23 Contractor shall be responsible for assuring that all the following sound pressure level criteria are met. Sound pressure level tests shall be carried out by the Section 230593 Contractor in compliance with the Section 230593 specifications.

B. Acoustical Criteria:

1. Noise levels due to equipment and ductwork to permit attaining sound pressure levels in all 8 octave bands in occupied spaces conforming to RC curves:

All occupied spaces ---------- RC-35

except

Occupied spaces within 15 foot radius from mechanical rooms, main supply and return duct shafts ---------- RC-40

Lobbies, Toilets, Commons Area ---------- RC-40

Kitchen ---------- RC-45-50

Teaching Laboratories ---------- RC-35-45

Research Labs with extensive telephone/speech use-------- RC-40-50

Research Labs (minimum speech communication) --------- RC-45-55

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Garage ---------- RC-50-60

Mechanical Rooms ---------- RC-60-80

C. Mechanical Acoustical Performance:

1. Air Distribution system equipment terminal device noise:

   Maximum permissible discharge sound-power levels in octave bands of airborne transmission through the terminal units or related pressure reducing devices, when operated in installed condition per Drawings and Specifications shall be as per Table 1, following:

TABLE 1 - Maximum PWL (dB re 10E-12 Watt)				
Octave Band	RC-30	RC-35	RC-40	RC-45
1	54	59	64	69
2	68	73	78	83
3	61	66	71	76
4	59	64	69	74
5	51	56	61	66
6	48	53	58	63
7	39	44	49	54

2. Pressure reducing variable air volume boxes radiated noise:

   Maximum permissible radiated sound-power levels in octave bands when operated in an installed condition over occupied spaces, shall be as per Table 2 following:

TABLE 2 - Maximum PWL (dB re 10E-12 Watt)				
Octave Band	RC-30	RC-35	RC-40	RC-45
1	54	59	64	69
2	62	67	72	77
3	58	63	68	73
4	55	60	65	70
5	53	58	63	68
6	50	55	60	65
7	46	51	56	61

3. Motor Acoustical Performance:

   Motor drives for pumps when installed per Drawings and Specifications shall operate with noise levels not exceeding 90dbA.

   Noise levels shall be determined in accordance with IEEE Standard #85 Test "Procedure for Air-Borne Noise Measurements on Rotating Electric Equipment.

4. Refrigeration Machine Cooler, Condenser, Compressor and Compressor Piping Acoustical Performance:

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The maximum permissible noise levels under design operating conditions, when measured in accordance with the methods and qualifications specified herein shall not exceed 90 dbA.

1.4 SUBMITTALS

A. Shop Drawings: Submit Shop Drawings and Product Data for the following items in accordance with the General Conditions of the Contract.

1. Each type of isolator including spring diameters, deflections, compressed spring height and solid spring height.
2. Sound Attenuators.
3. Sound Lining.
4. Inertia Bases.

B. Test Reports: Submit certified test reports showing compliance in accordance with General Conditions of the Contract of the following items:

1. Pressure drop and insertion loss ratings for sound attenuators.
2. Certification that sound lining meets erosion test method described in UL Publication No. 181.

PART 2 - PRODUCTS

2.1 PIPING AND EQUIPMENT ISOLATION

A. Manufacturer: Mason Industries, Inc., Vibro-Acoustics.

B. Other acceptable manufacturers offering equivalent products: Korfund, Amber/Booth Co., Vibration Mountings and Control Co., Kinetics.

C. Neoprene Mounting Pads (Specification Schedule Type 1)

1. Kinetics Noise Control Type NPD.
2. Minimum static deflection 0.04” for 0.22” thick pad.
3. Cross, double ribbed elastomer in-shear pads, capable of 60 or 120 PSI loading, depending on load density of equipment being isolated.
4. Material thickness as required to provide minimum deflections listed in table at end of the specification section.

D. Double Deflection Neoprene Mountings (Specification Schedule Type 2)

1. Mason Industries Type ND Mounting, Type DNR Rails.
2. Minimum static deflection 0.35 inch.
3. Bolt holes where required.
4. Steel rails above mountings to compensate for overhang where required.

E. Spring Isolator Mountings (Specification Schedule Type 3)

1. Mason Industries Type SLF.
2. Free-standing, laterally stable without housing, complete with 1/4 inch neoprene acoustical friction pads between base plate and support and with leveling bolts that must be rigidly bolted to equipment.
3. Spring diameters no less than 0.8 of the compressed height of the spring at rated load.
4. Springs with minimum additional travel to solid equal to 50 percent rated deflection.

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F. Restrained Spring Isolator Mountings (Specification Schedule Type 4)

1. Mason Industries Type SLR.
2. Spring isolator mounting equal to Type SLF but with housing that includes vertical resilient limit stops to prevent spring extension when weight is removed from equipment.
3. Provide hot dipped galvanized mountings exposed to weather.

G. Vibration Hangers (Specification Schedule Type 6)

1. Mason Industries Type DNH.
2. Spring and double deflection neoprene element in series.
3. Neoprene element minimum deflection 0.35 inch.
4. Spring diameters no less than 0.8 of compressed height of spring at rated load.
5. Springs with minimum additional travel to solid equal to 50 percent rated deflection.

H. Integral Structural Steel Base (Specification Schedule Type B)

1. Mason Industries Type WF.
2. Rectangular for equipment other than "T" or "L" shaped pump bases.
3. Pump bases for split case pumps to include supports for suction and discharge base ells.
4. Beams for perimeter members minimum depth equal to one tenth of the longest dimension of the base. Depth need not exceed 14 inches if deflection and misalignment is kept within acceptable limits by manufacturer.
5. Provide height saving brackets to provide a clearance of one inch.

I. Steel Rail Base (Specification Schedule Type B)

1. Mason Industries Type ICS.
2. Steel members welded to height saving brackets to cradle machines having legs or bases that do not require a complete supplementary base.
3. Provide members sufficiently rigid to prevent strains in the equipment.

J. Concrete Inertia Bases (Specification Schedule C)

1. Mason Industries Type K.
2. Rectangular structural beam or channel concrete forms for floating foundations.
3. Provide bases for split case pumps large enough for suction and discharge base ells supports.
4. In general, unless shown otherwise on the Drawings, provide bases with a minimum depth of one twelfth of the longest dimension of the base, but not less than 6 inches.
5. Forms to include minimum concrete reinforcement consisting of 1/2 inch bars or angles welded in place on 6 inch centers running both ways in a layer 1-1/2 inches above the bottom, or additional steel as is required by the structural conditions.
6. Forms furnished with drilled steel members with sleeves welded below the holes to receive equipment anchor bolts.
7. Provide height saving brackets to maintain a 1 inch clearance below base.

K. Flexible Butyl Hose Pipe Connectors (Up to 2")

1. Mason Industries Type RMM.
2. Flexible Butyl 150 lb. hose with brass screw type ends attached by expansion or swedging methods. Clamps are unacceptable.
3. Duty up to: 100 psi and 220 deg. F.
4. Hoses up to 1-1/4 inches shall be 12 inches in length and 1-1/2 inches to 2 inches shall be 18 inches in length.

L. Flexible Neoprene Sphere Pipe Connectors (2" to 12")

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1. Mason Industries Type MFNC and Type MFTNC.
2. Neoprene single-sphere type with 150 lb. ASA steel floating flanges.
3. Duty up to: 150 psi and 230 deg. F.
4. Movement limits: minimal 3/8 inch axial compression, 1/4 inch axial elongation, 3/8 inch lateral movement and 15 deg. angular movement.

2.2 SOUND ATTENUATORS

A. Acceptable Manufacturers: SEMCO Manufacturing, Industrial Acoustics Company, Acoustifoil Noise Control Products, Koppers, Rink, Commercial Acoustics, Dynasonics, Vibro-Acoustics, Price.

B. Factory prefabricated.

C. Shell:

1. Galvanized Steel: 22 ga. minimum.
2. Leakproof at pressure differential of 8 in. w.g.

D. Media:

1. Flamespread: Maximum 25.
2. Fuel contributed and smoke developed: Maximum 50.
3. Maximum 4.5 lbs. per cubic foot density glass or mineral fiber packed under 5 percent compression.
4. Filler to be inert, vermin and moisture proof.
5. Non-erosive and non-pregnable.

E. Internal Construction:

1. Galvanized perforated steel baffles: Minimum 24 gauge.
2. Cleanable construction.

F. Net Insertion Ratings:

1. Determined by duct-to-reverberant room test method at design airflow shall be as per Table 3 following:

TABLE 3			
		Sound Trap Dynamic Insertion Loss(db)	
Band No.	Band Center Freq. (HZ)	5 Feet	3 Feet
1	63	6	4
2	125	10	7
3	250	18	12
4	500	30	19
5	1000	42	23
6	2000	34	23

G. Maximum self-generated noise at 2000 ft. per minute face velocity shall be as per Table 4 following:

TABLE 4 - Sound Trap Self-Noise Level		
Band No.	Band Center Freq. (HZ)	Sound Trap Self-Noise (db re 10E-12W) 5 ft. & 3 ft.

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1	63	63
2	125	54
3	250	52
4	500	50
5	1000	47
6	2000	48

2.3 SOUND LININGS

A. Acceptable Manufacturer: Johns Manville Permacote, Linacoustic and Spiracoustic.

B. Other acceptable manufacturers offering equivalent products: Knauf, CertainTeed ToughGuard R.

C. Product: Fibrous glass, acrylic surface coating, stenciled NFPA, conforming to ASTM C1071, ASTM G21 and ASTM G22.

D. Minimum thickness: As indicated in Part 3 of this specification.

E. Sound Absorption Coefficient for 1" thickness per the following:

Frequency (cps) =	125	250	500	1000	2000	4000	NRC
Coefficient =	0.09	0.29	0.65	0.78	0.83	0.80	0.70

F. Flamespread: Maximum 25.

G. Fuel contributed and smoke developed: Maximum 50.

H. Suitable for duct velocity of 5000 fpm. Lining shall meet erosion test method described in UL Publication No. 181.

I. Dynamic loss coefficient: Maximum 1.2.

J. Thermal conductivity 0.25 Btu/hr/deg F/in. @ 75°F mean temperature.

K. Provide additional facing for protection of acoustical liner at plenum fan discharge plenum in field-built, single wall fan plenums. Liner shall be 26 gauge steel with perforated 28% minimum open area.

2.4 ADHESIVE AND SEALER

A. Acceptable Products: Adhesive, Benjamin Foster "81-99", or accepted equal, Sealer, Benjamin Foster "82-07" or accepted equal.

B. In conformance with NFPA 90A.

C. Flamespread: Maximum 25.

D. Fuel contributed and smoke developed: Maximum 50.

2.5 NON-HARDENING CAULKING

A. Acceptable Products: Tremco "Polybutene", Schuller or accepted equal.

B. Guaranteed to be permanently elastic.

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2.6 VIBRATION DAMPING COMPOUND

A. Acceptable Manufacturers: Soundcoat GP-1 Vibration Damping Compound, Korfund Dynamics Corporation Vibro-damp 80A, Kinetics, Vibro-Acoustics.

B. Non-burning.

C. Compound shall effectively damp vibrations for a broad frequency range between 10 Hz to 20 kHz.

D. Decay rate Geiger plate 45 dB/sec. at 72 deg. F.

2.7 EXTERNAL SOUND BARRIER INSULATION

A. Acceptable Manufacturers: Kinetics Noise Control, Vibro-Acoustics.

B. Model: KNM 100 ALQ-1.

C. Sound barrier shall be a barrier/decoupling layer composite consisting of 1.0 lb. per ft^2 mass barrier bonded to 1" fiberglass batting, non-woven porous scrim-coated glass cloth, quilted together to encapsulate the glass fibers. Provide with barrier tape for sealing joints.

D. Sound Transmission Loss:

1. Transmission loss when attached to outside of piping shall be as per the following table:

Band No.	Band Center Freq. (Hz)	Transmission Loss (dB)
1	125	13
2	250	16
3	500	24
4	1000	33
5	2000	43
6	4000	49
-	STC	28

E. Flamespread: Maximum 25.

F. Fuel contributed and smoke developed: Maximum 50.

2.8 EXTERNAL SOUND BARRIER INSULATION (PIPING)

A. Acceptable Manufacturers: Kinetics Noise Control, Vibro-Acoustics.

B. Model: KNM 100 ALQ-1.

C. Sound barrier shall be a barrier/decoupling layer composite consisting of 1.0 lb. per ft^2 mass barrier bonded to 1" fiberglass batting, non-woven porous scrim-coated glass cloth, quilted together to encapsulate the glass fibers. Provide with barrier tape for sealing joints.

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D. Sound Transmission Loss:

1. Transmission loss when attached to outside of piping shall be as per the following table:

Band No.	Band Center Freq. (Hz)	Transmission Loss (dB)
1	125	13
2	250	16
3	500	24
4	1000	33
5	2000	43
6	4000	49
-	STC	28

E. Flamespread: Maximum 25.

F. Fuel contributed and smoke developed: Maximum 50.

2.9 EXTERNAL SOUND BARRIER INSULATION (SHEET METAL)

A. Acceptable Manufacturers: Kinetics Noise Control, Vibro-Acoustics.

B. Model: KNM 100 ALQ-1.

C. Sound barrier shall be a barrier/decoupling layer composite consisting of 1.0 lb. per ft^2 mass barrier bonded to 1" fiberglass batting, non-woven porous scrim-coated glass cloth, quilted together to encapsulate the glass fibers. Provide with barrier tape for sealing joints.

D. Sound Transmission Loss:

1. Transmission loss when attached to outside of piping shall be as per the following table:

Band No.	Band Center Freq. (Hz)	Transmission Loss (dB)
1	125	13
2	250	16
3	500	24
4	1000	33
5	2000	43
6	4000	49
-	STC	28

E. Flamespread: Maximum 25.

F. Fuel contributed and smoke developed: Maximum 50.

PART 3 - EXECUTION

3.1 GENERAL - PIPING AND EQUIPMENT ISOLATION

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A. Unless otherwise noted on the Equipment Mounting Schedule, provide mechanical equipment mounted on vibration isolators to prevent the transmission of vibration and mechanically transmitted sound to the building structure. Vibration isolators to be selected in accordance with the weight distribution so as to produce reasonable uniform deflection. Deflections to be as noted on the Equipment Mounting Schedule included at the end of this section.

B. Coordinate work with other trades to avoid rigid contact with the building. Inform other trades following the isolation work, to avoid any contact which would reduce the vibration isolation.

C. The installation or use of vibration isolators must not cause any change of position of equipment or piping which would result in stresses in piping connections or misalignment of shafts or bearings. In order to meet this objective, maintain equipment and piping in a rigid position during installation. Do not transfer the load to the isolator until the installation is complete and under full operational load.

D. Support the machine to be isolated with a structural steel frame.

E. Provide brackets to accommodate the isolator and provide a mechanical stop. The vertical position and size of the bracket to be recommended by the isolator manufacturer.

F. For restrained spring isolators, use housing as blocking during erection so that installed and operating heights can be the same. Maintain a minimum clearance of 1/2 inch around restraining bolts between housing and spring to avoid interference with spring action. Limit stops to be out of contact during normal operation.

3.2 HANGERS

A. Install type 2 or 3 vibration isolation piping hangers where indicated in Equipment Mounting Schedule at the end of this section and within 20 feet (measured along piping) upstream and downstream of all pumps 3 HP or larger.

B. Install the isolators with the isolator hanger box attached to or hung as close as possible to the structure.

C. Suspend the isolators from substantial structural members, not from slab diaphragm unless specifically accepted.

D. Align hanger rods to clear hanger box.

3.3 EQUIPMENT BASES

A. Provide minimum operating clearance between the equipment frame or rigid steel base frame and the housekeeping pad or floor of 1 inch. Provide minimum operating clearance between concrete inertia base and the housekeeping pad or floor of 1 inch.

3.4 COIL BASES

A. Mount floor supported coil section on a 1/4" thick layer of ribbed neoprene pad, with a 16 gauge galvanized steel plate between coil frame and pad. Coil shall be mounted on a concrete curb of sufficient height to allow coil drain pan to be sloped in two directions to drain pan bottom outlet with P-trap and/or refrigerant suction line traps to be installed without hitting floor.

3.5 FLEXIBLE PIPING CONNECTORS

A. Provide flexible connectors for equipment that is supported by or mounted on vibration isolators except when connected piping is made up with a Victaulic Flex coupling system. Connectors to be installed under Section 232113.

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B. Hoses shall be installed on the equipment side of the shut-off valves and horizontally wherever possible.

C. Provide connectors at pump suction and discharge, and elsewhere as required to accommodate thermal expansion, vibration and misalignment.

D. Provide flexible connectors on all suction and discharge connections to all base mounted centrifugal pumps, vertical turbine pumps, air compressors, dryers, vacuum pumps or other equipment items producing vibration, shock, noise, or thermal motion of piping.

E. Provide 300 psi companion flanges for connector for threaded, welded, soldered, or brazed piping as appropriate.

F. Connectors to be aligned, centered, and shall not bear weight of pipe, fittings, or pipeline accessories such as valves. Piping shall be supported both sides of horizontal or vertical connectors.

3.6 PIPE FLOOR SUPPORTS

A. Provide type 3 mountings with a minimum static deflection of 1.5 inches on horizontal pipe floor supported at slab in equipment rooms above grade.

3.7 SOUND ATTENUATORS

A. Install in accordance with manufacturers' recommendations to obtain published performance.

B. After installation, measure total system pressure before and after attenuators.

C. If pressure loss exceeds maximum static pressure loss schedules on drawings: modify entrance or discharge aerodynamic flow to obtain specified performance.

D. For maximum structural integrity, sound attenuator baffles should be installed in a vertical position; where this is not possible, structural reinforcement is required for attenuators wider than 24 in.

E. When elbows precede attenuators, baffles shall be parallel to the plane of the elbow radius.

3.8 SOUND LININGS

A. Dimensions of lined ductwork are clear inside dimensions after lining has been installed.

B. Sound linings to be held in place with mechanical fasteners as per the latest SMACNA duct liner application standard, with joints and any tears to be coated with Benjamin Foster or accepted equal adhesive. The transverse joints to be coated prior to installation so that the ends of the liner are compressed together while the adhesive is still moist, forming a seal of the leading and trailing edge of each joint. Excess adhesive to be brushed to an even finish over the joint.

C. Provide continuous sheet metal edge protectors at entering and leaving edges of lined duct sections where adjacent to unlined duct sections.

D. Extent of 1” ductwork sound linings:

1. Upstream of toilet/general exhaust fans and relief air fans, a minimum distance of 20'-0".
2. Transfer air ducts and shaft return stub ducts.
3. In all supply, all return and all rectangular exhaust ducting.
4. Return air elbow boots over ceiling grilles.
5. In plenums above supply diffusers.
6. Elsewhere when specifically indicated on drawings.
7. Do not install liner in duct serving evaporative cooled systems 10’-0” downstream of media.

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E. Extent of plenum sound linings:

1. Mixed and outside air plenum walls and ceilings.
2. Supply air discharge and filter plenum walls and ceiling.
3. Return/Exhaust air plenums.
4. Return air plenum from riser to mixed air plenum.
5. Return/Exhaust air plenums inside packaged rooftop units when not factory installed.

F. Extent of perforated metal facing on sound linings:

1. In supply air fan discharge plenums.
2. In high velocity supply air ducts where shown on drawings.

3.9 SOUND PROOFING OF CONSTRUCTION

A. Required for opening between ductwork and piping and following construction:

1. Equipment room walls.
2. Floors, except in shafts.
3. Roofs, specifically inside roof curbs for mechanical equipment and where ductwork penetrates roof deck.

B. Sound proofing:

1. Fill openings with tightly packed fibrous glass blanket or board for full depth of penetration.
2. Caulk each side of opening with non-hardening, non-aging caulking compound.

3.10 EXTERNAL VIBRATION DAMPENING

A. For typical floor supply duct take-offs from main supply riser when required to meet specified sound levels, provide 1/8 inch thick duct exterior coating of vibration dampening compound. These treatments to be provided over the rectangular portion (flat sides) of the floor take-off ducts.

3.11 EXTERNAL SOUND BARRIER INSULATION

A. Provide foam composite, applied over the vane axial fan casings (both supply and return) extending from the inlet side of the intake sound traps, to the leaving side of the discharge sound traps, inclusive of all flexible connectors.

B. Provide a duct enclosure of 2 layers of 5/8" gypsum board with staggered seams extending from the point that the ducts leave the rooftop unit or fan plenum to the leaving side of the discharge sound trap(s). A minimum clearance of 1" shall be maintained between the ductwork and the enclosure walls; all voids between the enclosure and the ductwork to be filled with loose batt fiberglass insulation. The points at which the ductwork penetrates the enclosure; the sheetrock is to be cut away from the ductwork by 1/4" to 1/2" and the void is to be filled with non-hardening caulk. Caulk shall be fire-rated if enclosure is required to be fire-rated.

3.12 EQUIPMENT MOUNTING SCHEDULE

A. Manufacturer: Mason Industries, Inc., Kinetics, Vibro-Acoustics.

B. Schedule: See the following pages.

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EQUIPMENT VIBRATION ISOLATION SCHEDULE						
EQUIPMENT TYPE	SLAB ON GRADE			20 FT. FLOOR SPAN		
	BASE TYPE	ISOL TYPE	MIN. DEFL. (IN.)	BASE TYPE	ISOL TYPE	MIN DEFL. (IN.)
PUMPS						
A. Close Coupled						
1. Up to 7 1/2 HP	B/C	2	.25	C	3	.75
2. 10 HP & Over	C	3	.75	C	3	.75

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EQUIPMENT VIBRATION ISOLATION SCHEDULE						
EQUIPMENT TYPE	SLAB ON GRADE			20 FT. FLOOR SPAN		
	BASE TYPE	ISOL TYPE	MIN. DEFL. (IN.)	BASE TYPE	ISOL TYPE	MIN DEFL. (IN.)
PUMPS						
A. Flexible Coupled						
1. Up to 40 HP	C	3	.75	C	3	.75
2. 50 to 125 HP	C	3	.75	C	3	.75
3. 150 HP & Over	(See Note 1)			(See Note 1)		

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EQUIPMENT VIBRATION ISOLATION SCHEDULE						
EQUIPMENT TYPE	SLAB ON GRADE			20 FT. FLOOR SPAN		
	BASE TYPE	ISOL TYPE	MIN. DEFL. (IN.)	BASE TYPE	ISOL TYPE	MIN DEFL. (IN.)
CENTRIFUGAL FANS & VENTILATION SETS						
A. Up to 22 in. Wheel dia.	A/B	2	.25	A/B	3	.75
B. 24 in. Wheel dia. & Over						
1. Up to 50 hp						
a. Up to 300 RPM	(See Note 2)			(See Note 2)		
b. 301 to 500 RPM	B	3	1.5	B	3	1.5
c. 501 RPM & Over	B	3	.75	B	3	.75
2. 60 HP & Over						
a. Up to 300 RPM	(See Note 2)			(See Note 2)		
b. 301 to 500 RPM	B/C	3	.75	C	3	1.5
c. 501 RPM & Over	B/C	3	.75	C	3	1.5
PACKAGED AIR HANDLING EQUIPMENT						
A. Up to 10 HP	A	2	.25	A	3	.75
B. 15 HP & Over	A	2	.25	A	3	.75

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EQUIPMENT VIBRATION ISOLATION SCHEDULE						
EQUIPMENT TYPE	SLAB ON GRADE			20 FT. FLOOR SPAN		
	BASE TYPE	ISOL TYPE	MIN. DEFL. (IN.)	BASE TYPE	ISOL TYPE	MIN DEFL. (IN.)
PACKAGED ROOFTOP AIR CONDITIONING UNIT	--	--	--	D	3	.75

BASE TYPES:

A = NO BASE, ISOLATORS ATTACHED DIRECTLY TO EQUIPMENT
B = STRUCTURAL STEEL RAILS OR BASE
C = CONCRETE INERTIA BASE
D = CURB-MOUNTED BASE

ISOLATOR TYPES

1 = RUBBER OR GLASS FIBER PAD
2 = RUBBER FLOOR ISOLATOR OR HANGER
3 = SPRING FLOOR ISOLATOR OR HANGER
4 = RESTRAINED SPRING ISOLATOR
5 = SPRING AND RUBBER IN SERIES HANGER

NOTES:

1. CONTRACTOR SHALL PROVIDE VIBRATION ISOLATION AND CALCULATIONS STAMPED BY A LICENSED PROFESSIONAL ENGINEER.

2. TO AVOID ISOLATOR RESONANCE PROBLEMS, SELECT ISOLATOR DEFLECTION SO THAT NATURAL FREQUENCY IS 40% OR LESS THAN LOWEST OPERATING SPEED OF EQUIPMENT (SEE ASHRAE HVAC APPLICATIONS HANDBOOK, 2007 EDITION).

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PUMPS						
A. Close Coupled						
1. Up to 7 1/2 HP	C	3	.75	C	3	.75
2. 10 HP & Over	C	3	1.5	C	3	1.5

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EQUIPMENT VIBRATION ISOLATION SCHEDULE						
EQUIPMENT TYPE	30 FT. FLOOR SPAN			40 FT. FLOOR SPAN		
	BASE TYPE	ISOL TYPE	MIN. DEFL. (IN.)	BASE TYPE	ISOL TYPE	MIN DEFL. (IN.)
PACKAGED ROOFTOP AIR CONDITIONING UNIT	A/B	3	1.5	A/B	3	2.5

BASE TYPES:

A = NO BASE, ISOLATORS ATTACHED DIRECTLY TO EQUIPMENT
B = STRUCTURAL STEEL RAILS OR BASE
C = CONCRETE INERTIA BASE
D = CURB-MOUNTED BASE

ISOLATOR TYPES

1 = RUBBER OR GLASS FIBER PAD
2 = RUBBER FLOOR ISOLATOR OR HANGER
3 = SPRING FLOOR ISOLATOR OR HANGER
4 = RESTRAINED SPRING ISOLATOR
5 = SPRING AND RUBBER IN SERIES HANGER

NOTES:

1. CONTRACTOR SHALL PROVIDE VIBRATION ISOLATION AND CALCULATIONS STAMPED BY A LICENSED PROFESSIONAL ENGINEER.

2. TO AVOID ISOLATOR RESONANCE PROBLEMS, SELECT ISOLATOR DEFLECTION SO THAT NATURAL FREQUENCY IS 40% OR LESS THAN LOWEST OPERATING SPEED OF EQUIPMENT (SEE ASHRAE HVAC APPLICATIONS HANDBOOK, 2007 EDITION).

END OF SECTION 23 05 40

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Community School

SECTION 23 05 48 - MECHANICAL SEISMIC CONTROL

PART 1 - GENERAL

1.1 WORK INCLUDED

A. Anchorage and seismic restraint systems for all Division 23 isolated and non-isolated equipment, ductwork and piping systems.

B. Equipment/piping/ductwork to be isolated and/or seismically supported shall include but not be limited to the following:

1. Piping
2. Ductwork
3. Sound Attenuators
4. Unit Heaters
5. Radiant Ceiling Panels
6. Supply Air Fans
7. Hanging Exhaust Fans
8. Air Compressors
9. Heat Exchangers
10. Computer Room AC Equipment
11. Domestic Water Heaters
12. Refrigerant Compressors
13. Piping
14. Ductwork

1.2 RELATED WORK

A. Requirements: Provide Mechanical Seismic Control in accordance with the Contract Documents.

B. Section 230500 - Basic Mechanical Requirements.

C. Section 230529 - Basic Mechanical Materials and Methods.

D. Section 230540 - Mechanical Sound and Vibration Control.

1.3 REFERENCES

A. International Building Code, Current Edition in use by Jurisdictional Authority.

B. NFPA Bulletin 90A, Current Edition.

C. UL Standard 181.

D. SMACNA Seismic Restraint Manual: Guidelines for mechanical systems.

1.4 SYSTEM DESCRIPTION

A. The Division 23 Contractor shall be responsible for supplying and installing equipment, vibration isolators, flexible connections, rigid steel frames, anchors, inserts, hangers and attachments, supports, seismic snubbers and bracing to comply with the following:

1. Short period design spectral response acceleration coefficient S_{DS}= .613.
2. One-second period design spectral response acceleration coefficient S_{D1}= 0.330.
3. Site Class D.

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4. Seismic Design Category D.

B. The following components have a component importance factor I_P of 1.5:

1. Fire Sprinkler Protection System
2. Gas Piping

All other components have an importance factor I_P of 1.0.

1.5 QUALITY ASSURANCE

A. All supports, hangers, bases, anchorage and bracing for all isolated equipment and non-isolated equipment shall be designed by a professional engineer licensed in the state where the project is located, employed by the restraint manufacturer, qualified with seismic experience in bracing for mechanical equipment. Shop drawings included with deferred submittal for earthquake bracing and anchors from the restraint manufacturer shall bear the Engineer's signed professional seal. All calculations/design work required for the seismic anchorage and restraint of all Division 23 equipment and systems shall be provided by a single firm.

B. The above qualified professional engineer shall determine specific requirements for equipment anchorage and restraints, locations and sizes based on shop drawings for the mechanical equipment which have been submitted, reviewed and accepted by the Architect/Engineer for this project.

C. Seismic Engineer or the Engineer's Representative shall field inspect final installation and certify that bracing and anchorage are in conformance with the Seismic Engineer's design, the requirements of this specification section, and all seismic restraint requirements of the building code. A certificate of compliance bearing the Seismic Engineer's signed Professional Engineer's seal shall be submitted and shall be included in each copy of the Operation and Maintenance Manuals.

D. The Division 23 Contractor shall require all equipment suppliers to furnish equipment that meets the seismic code, with bases/skids/curbs designed to receive seismic bracing and/or anchorage. All isolated and non-isolated mechanical equipment bracing to be used in the project shall be designed from the equipment submittals and certified to be code-compliant by the equipment manufacturer for seismic description loads defined above, with direct anchorage capability.

1.6 SUBMITTALS

A. A single submittal shall be provided for all seismic anchorage and restraints for all Division 23 equipment and systems provided as part of this project. Individual submittals for specific systems will not be accepted.

B. Submit shop drawings, calculations, and printed data for the following items under provisions of the General Conditions of the Contract:

1. Complete engineering calculations and shop drawings for all seismic restraint requirements for all equipment as required by the IBC.
2. The professional seal of the engineer who is responsible for the design of the Seismic Restraint System.
3. Details for all seismic bracing.
4. Details for steel frames, concrete inertia bases, and housekeeping pads. Include dimensions, embed depths, dowelling details, and concrete reinforcing requirements.
5. Clearly outlined procedures for installing and adjusting the isolators, seismic bracing anchors, snubbers, cables, and bolt connections.
6. Floor plan noting the locations, size, and type of anchorage and restraint to be used.
7. Include confirmation that all calculations are based on the design criteria listed in Paragraph 1.4.A of this Section.
8. Certificate of Compliance.

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PART 2 - PRODUCTS

2.1 RESTRAINT EQUIPMENT AND SYSTEMS

A. Acceptable Manufacturers and Suppliers for Non-Isolated Systems:

1. Mason Industries, Inc.
2. Korfund
3. Amber/Booth Company
4. Vibration Mountings and Control Company
5. Kinetics
6. International Seismic Application Technology
7. Tolco
8. Vibro Acoustics
9. Hilti

B. Manufacture of restraints and anchors for isolated equipment required by this specification section shall also furnish the vibration isolators required by Specification Section 230540.

2.2 SNUBBERS

A. Snubbers shall be all-directional and consist of interlocking steel members restrained by replaceable shock absorbent elastomeric materials a minimum of 3/4 inch thick.

B. Snubbers shall be manufactured with an air gap between hard and resilient material of not less than 1/8 inch or more than 1/4 inch.

C. Snubbers shall be Mason Industries Z - 1011 or accepted equivalent.

PART 3 - EXECUTION

3.1 DESIGN AND INSTALLATION

A. General:

1. All mechanical equipment, piping and ductwork shall be braced, anchored, snubbed or supported to withstand seismic disturbances in accordance with the criteria of this specification. Provide all engineering, labor, materials and equipment for protection against seismic disturbances as specified herein. The following mechanical components are exempt from seismic restraint requirements:

   a. Components in Seismic Design Categories A and B.
   b. Components in Seismic Design Category C that have an importance factor I_P of 1.0.
   c. Components that have an importance factor I_P of 1.0, that are mounted less than four feet above the floor, that weigh less than 400 pounds, and that have flexible ductwork, piping, and conduit connections.
   d. Components that have an importance factor I_P of 1.0, that weigh 20 pounds or less, and that have flexible ductwork, piping, and conduit connections.

2. Powder-actuated fasteners (shot pins) shall not be used for component anchorage in tension applications in Seismic Design Category D, E, or F.

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3. Attachments and supports for mechanical equipment shall meet the following provisions:

   a. Attachments and supports transferring seismic loads shall be constructed of materials suitable for the application and designed and constructed in accordance with a nationally recognized structural code such as, when constructed of steel, AISC, Manual of Steel Construction (Ref. 9.8-1 or 9.8-2).
   b. Friction clips shall not be used for anchorage attachment.
   c. Expansion anchors shall not be used for mechanical equipment rated over 10 hp (7.45 kW). Exception: Undercut expansion anchors.
   d. Drilled and grouted-in-place anchors for tensile load applications shall use either expansive cement or expansive epoxy grout.
   e. Supports shall be specifically evaluated if weak-axis bending of light-gauge support steel is relied on for the seismic load path.
   f. Components mounted on vibration isolation systems shall have a bumper restraint or snubber in each horizontal direction. The design force shall be taken as $2F_p$. The intent is to prevent excessive movement and to avoid fracture of support springs and any non-ductile components of the isolators.
   g. Seismic supports shall be constructed so that support engagement is maintained.

B. Install ceiling mounted items in accordance with ASTM C 636.

   1. Ceiling mounted air terminals or services weighing less than 20 pounds shall be positively attached to the ceiling suspension main runners or to cross runners with the same carrying capacity as the main runners.
   2. Terminals or services weighing 20 pounds but not more than 56 pounds, in addition to the above, shall have two No. 12 gauge hangers connected from the terminal or service to the ceiling system hangers or to the structure above. These wires may be slack.
   3. Terminals or services weighing more than 56 pounds shall be supported directly from the structure above by approved hangers.

C. Spring Isolated Equipment:

   1. All vibration isolated equipment shall be mounted on rigid steel frames or concrete bases as described in the vibration control specifications unless the equipment manufacturer certified direct attachment capability. Each spring mounted base shall have a minimum of four all-directional seismic snubbers that are double acting and located as close to the vibration isolators as possible to facilitate attachment both to the base and the structure. Snubbers shall be installed with factory set clearances.

D. Non-Isolated Equipment:

   1. The Division 230548 Contractor shall be responsible for thoroughly reviewing all drawings and specifications to determine all equipment to be restrained. This Contractor shall be responsible for certifying that non-isolated equipment is mounted and braced such that it adheres to the system description criteria in this specification section.

E. Piping:

   1. Seismic braces for piping may be omitted when the distance from the top of the pipe to the supporting structure is 12" or less. Where pipes are supported by a trapeze, seismic braces may be omitted when the trapeze shall be supported by hangers having a length of 12” or less.
   2. A rigid piping system shall not be braced to dissimilar parts of a building or two dissimilar building systems that may respond in a different mode during an earthquake. Examples: Wall and a roof; solid concrete wall and a metal deck with lightweight concrete fill.
   3. Unbraced piping attached to in-line equipment shall be provided with adequate flexibility to accommodate differential displacements.
   4. At the interface of adjacent structures or portions of the same structure that may move independently, utility lines shall be provided with adequate flexibility to accommodate the anticipated differential movement between the ground and the structure.

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5. Provide large enough pipe sleeves through walls or floors to allow for anticipated differential movements.

F. Ductwork:

1. Seismic restraints are not required for HVAC ducts with importance factor I_P of 1.0, provided that either of the following conditions are met for the full length of each duct run:

   a. HVAC ducts are suspended from rod hangers and hangers are 12 inches or less in length from the point rod attaches to duct, to the point rod connects to the supporting structure. Rods must be secured to both top and bottom cross angles with locking nuts above and below angle iron.
   b. HVAC ducts have a cross-sectional area of less than 6 square feet.
   c. This exception is not valid if the top of ductwork is not secured to hanger rods to limit pendulum length to 12 inches.

2. Equipment items installed in-line with the duct systems with an operating weight greater than 75 pounds shall be supported and laterally braced independently of the duct system.

END OF SECTION 23 05 48

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SECTION 23 05 93 - TESTING, ADJUSTING AND BALANCING

PART 1 - GENERAL

1.1 RELATED WORK

A. The General Conditions, Supplementary Conditions and Division 1, General Requirements apply to this Section, and Contractor shall review and adhere to all requirements of these Documents.

B. Related work specified in other Sections:

Section 230500 - Basic Mechanical Requirements
Section 233300 – Ductwork and Accessories

1.2 SYSTEM DESCRIPTION

A. The work includes, but is not limited to the following:

1. Upon completion of the installation of all the plumbing, air and heating or cooling water systems, all necessary adjustments shall be made to provide capacities listed on the Drawings to properly balance these systems.
2. Submittals and written reports as specified.
3. Testing requirements as described in Specification Section 230500, paragraph 1.16.
4. Witness duct leakage test required by Specification Section 233300 – Ductwork and Accessories.
5. Provide assistance, in cooperation with the various trades, in the final adjustments and test of the Life Safety Systems to comply with the requirements of the Building and Fire Departments.
6. Provide Owner training as described in Specification Section 230500.

1.3 QUALITY ASSURANCE

A. Work under this section shall be executed under the direct supervision of a Registered Professional Engineer having an established professional office in the State of Utah and having an experience record of not less than five (5) years in the mechanical contracting industry, engaged in testing, balancing and adjusting of air and hydronic mechanical systems for not less than two (2) years of that time, or, under the direct supervision of a qualified testing, adjusting and balancing supervisor, possessing certification from the National Environmental Balancing Bureau (NEBB) or from the Associated Air Balance Council (AABC).

B. Comply with the applicable procedures in the chapter on Testing, Adjusting and Balancing in the latest ASHRAE Edition of the NEBB, AABC, and SMACNA Test and Balance documents.

C. Calibration and maintenance of instruments shall be in accordance with manufacturer's standards and recommendations, and calibration histories for each instrument shall be available for examination.

D. Accuracy of measurements shall be in accordance with the applicable measurement means as listed in the latest edition of NEBB, AABC, and SMACNA Test and Balance documents.

E. Allowable Tolerances:

1. Tolerances of adjustment for air handling systems are plus or minus 10% for supply, return, and exhaust systems at air devices and plus 10%/minus 0% at all fans/source equipment from figures shown on drawings.

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2. Tolerances of adjustment for hydronic systems, are plus or minus 10% of design conditions shown on drawings at terminal devices and equipment, and plus 10%/minus 0% at all pumps.

F. Final Testing, Adjusting and Balancing of all hydronic and air systems shall be performed by an approved separate professional Testing, Adjusting and Balancing subcontractor meeting the above Quality Assurance requirements. Acceptable separate professional subcontractors approved to work on this project are as follows:

1. BTC Services, Inc.
2. Certified Testing & Balancing, Inc.
3. RS Analysis, Inc.
4. Bonneville Test & Balance

G. Subcontractors not listed above must submit for acceptance.

H. Within 30 days after execution of the Owner-Contractor Agreement, transmit to Architect/Engineer the name and qualifications of the organization proposed to perform the services.

1.4 SUBMITTALS

A. Procedure: Submit Qualifications, Documentation, Test Schedules and Reports in accordance with the General Conditions of the Contract.

B. Qualifications:

1. Submit three copies of documentation to confirm compliance with Quality Assurance provisions:

   a. Organization supervisor and personnel training and qualifications.
   b. Specimen copy of each of the report forms proposed for use.

C. Preliminary Report: At least fifteen days prior to starting field work, submit three copies of:

1. A set of report forms filled out as to the design flow values and the installed equipment pressure drops, and the required CFM for air terminals.

2. A complete list of instruments proposed to be used, organized in appropriate categories, with data-sheets for each. Show:

   a. Manufacturer and model number.
   b. Description and use when needed to further identify the instrument.
   c. Size of capacity range.
   d. Latest calibration date.

3. Architect/Engineer will review submittals for compliance with Contract Documents, and will return one set marked to indicate:

   a. Discrepancies noted between measured data and Contract Documents.
   b. Additional, or more accurate, instruments required.
   c. Requests for re-calibration of specific instruments.

D. Schedules:

1. Schedule tests to comply with project completion schedules.
2. Schedule testing and balancing of parts of the systems which are delayed due to seasonal, climatic, occupancy, or other conditions beyond control of the Contractor, as early as the proper conditions will allow, after consultation with Architect/Engineer.
3. Submit reports of delayed testing promptly after execution of those services.

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E. Final Report: At least fifteen days prior to Contractor's request for final inspection, submit three copies of final reports, on applicable reporting forms, for review. Submit a fourth copy directly to the Engineer. Each individual final reporting form must bear the signature of the person who recorded data and that of the NEBB or AABC certified supervisor of the reporting organization. Identify instruments of all types which were used and last date of calibration of each. Report shall include:

1. A detailed letter to Engineer outlining all abnormal or notable conditions not covered in above data specifically identifying all locations where specified flow tolerances could not be met.
2. A set of reduced black and white or blueline prints with all air openings clearly marked to correspond with data sheets and with thermometer locations clearly marked.
3. Data sheets showing amount of air handled at each opening, instrument used, velocity readings, and manufacturer free area factor.
4. Data sheets giving log of room temperatures in rooms exhibiting objectionable temperatures during the heating season. Logs shall be taken when outside temperature is 30 deg.F or colder.
5. Data sheets giving log of room temperatures in rooms exhibiting objectionable temperatures during the cooling season. Logs shall be taken with full occupant load, full lighting, and maximum solar conditions.
6. Equipment data sheets giving make, size and model, of fans, starters and motors with rated amps and service factors, and drives. Include pumps, supply fans, exhaust and recirculating fans.
7. Operating data including fan RPM, inlet and outlet pressures, pressure drop across filters, face and bypass dampers, and measured motor current and voltage, BHP and CFM (total).
8. Heating equipment operating data including air temperatures entering and leaving heating coils (maximum air temperature rise), together with corresponding air flow and air pressure drop, water temperature entering and leaving heating coil, water flow and pressure drop through heating coil.
9. Cooling equipment operating data including air temperatures entering and leaving cooling coils together with corresponding air flow and air pressure drop, water temperature entering and leaving cooling coil, and water flow and pressure drop through cooling coil.
10. Cooling tower operating data including measurements of hot water, cold water and wet-bulb temperatures, circulating water flow rate, fan RPM, fan power and wind velocity.
11. Equipment and operating data as required to show performance of pumps, heat exchangers, domestic hot water circulating systems, heating, ventilating, and air conditioning units, cabinet heaters, unit heaters, unit ventilators, fans and temperature control devices.
12. Sound pressure levels showing readings in all 8 octave bands and plotted on RC(II) charts shall be submitted for the following:

    a. All sides of Mechanical Rooms.
    b. Lobbies, Labs, and Commercial Area.
    c. Conference Rooms.
    d. Spaces within 20 ft. of parking garage ventilation fan inlets and outlets.
    e. All spaces exhibiting abnormally high or annoying noise levels.

13. Domestic hot water recirculation data including flow at each branch shown requiring specific flow, and at the pump.

1.5 PROJECT CONDITIONS

A. The following job conditions must be verified before any testing, adjusting or balancing of the environmental systems begin:

1. Installation of the designated system is complete and in full operation.
2. On hydronic systems, strainers shall be cleaned, temperature control valve operation shall be checked, pump rotation shall be checked, pressure reducing valves shall be adjusted, and other such conditions requiring correction.

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3. Air systems shall be checked for dirty filters, filter leakage, equipment vibrations, damper operation, fan rotation, and other such conditions requiring correction.

PART 2 – PRODUCTS (NOT USED)

PART 3 - EXECUTION

3.1 PROCEDURE

A. Confirm that project conditions have been verified and that necessary corrections have been made before proceeding with the Work.

B. The Test and Balance Contractor must proportion air/water flows in the system while introducing a minimum amount of resistance. All systems are to be proportionally balanced.

C. Hydronic Systems:

1. Using system flow meters and/or contact pyrometer, the balancing firm shall adjust the quantity of water or glycol solution handled by each pump and supplied to each coil, solar collector, heat exchanger, cooling tower, and such other primary source equipment to meet design requirements, and mark each balancing cock at final setting.

D. Air Systems:

1. The balancing firm shall adjust all dampers, diffusers, registers, belts and sheaves for the delivery and distribution of air quantities shown in the Contract Documents and shall mark each balancing device at final setting.
2. Adjust fan speeds and motor drives within drive limitations for required air volume, provide new sheaves as necessary, or adjustable bands on constant volume plenum fans, and notify Division 26 Contractor of any thermal overloads that need to be changed/replaced.
3. Measure static air pressure conditions on air supply units, including individual filter and coil pressure drops, and total pressure across the fan. Make allowances for 0.5” w.c., equivalent to 50% loading of filters.
4. Exhaust and recirculation air systems shall be adjusted for air quantities shown on Drawings.
5. Adjust outside air automatic dampers, outside air, return air, and exhaust dampers for design conditions.
6. Measure temperature conditions across outside air, return air, and exhaust dampers to check leakage.
7. Measure building static pressure in both economizer mode and minimum outside air mode, and adjust supply, return and exhaust air systems to provide the required relationship between each to maintain approximately 0.05 inches water column positive static pressure at the Building Entries.
8. Distribution system shall be adjusted to obtain uniform space temperatures free from objectionable drafts and noise.
9. Where multiple air diffusers are shown on one terminal box, adjust dampers for the delivery and distribution of air quantities shown in the Contract Documents.
10. Multi-zone units are to be checked for motorized damper leakage. Air quantities are to be adjusted with all mixing dampers set first for cooling, then heating, then modulating. If it is significantly higher for heating or cooling, measure motor current and adjust fan speed for heating.
11. Dust collection system shall be adjusted for air quantities shown on the Drawings with all blast gates open and all floor sweeps closed.
12. Variable Air Volume System Powered Terminal Units: Set each volume controller to CFM setting shown on drawings, confirm that each unit has all control air connections properly made and confirm proper operation for automatic variable air volume temperature control.
13. Set all VAV boxes at minimum/maximum air flow shown on drawings.

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14. Adjust air flow switches for proper operation on all fan powered VAV boxes.
15. Test Run: In order to determine that the system installation is complete and will operate satisfactorily, make a test run with equipment operating per normal temperature control schedule and sequence for a period of seven days for each heating and cooling season. Contractor shall notify Architect in writing when he is ready to begin test. Provide personnel to run test and operate and adjust equipment as may be required during test run. Keep a log for each day indicating all malfunctions that occurred and corrections and adjustments made. Be responsible for operation of equipment during this test.
16. Report: After all adjustments are made, a detailed report shall be prepared by the balancing firm and submitted to the Architect for approval. Owner reserves the right to spot check the report prior to final acceptance.

E. Plumbing System

1. Hot Water Recirculation Systems: Set flow at each balancing valve shown. Record flow at each pump. Verify the proper installation of automatic flow control valves.

END OF SECTION 23 05 93

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SECTION 23 07 00 - MECHANICAL INSULATION

PART 1 - GENERAL

1.1 RELATED WORK

A. Requirements: Provide insulation in accordance with the Contract Documents.

B. Related work specified in other Sections:

Section 224450 - Plumbing Equipment
Section 230500 - Basic Mechanical Requirements
Section 230529 - Basic Mechanical Materials and Methods
Section 230540 - Mechanical Sound and Vibration Control
Section 232113 – HVAC Piping & Specialties
Section 233100 – Air Distribution
Section 236400 - Refrigeration

1.2 SYSTEM DESCRIPTION

A. The mechanical insulation work required by this Section shall include materials and methods as described herein and on the Drawings and as required by applicable energy codes.

B. The work includes, but is not limited to providing insulation on the following:

1. Plumbing Systems:

   Domestic Hot Water-Supply, Recirculating, Hot Water Converters, and Storage Tanks
   Tempered Domestic Water-Supply, Recirculating and Storage Tanks
   Tempered Domestic Water Circulating
   Domestic Cold Water
   Primary Roof Drain System
   Overflow Roof Drain Bowls
   Chilled Drinking Water Piping, Recirculating and Storage Tanks

2. Chilling Systems:

   Refrigerant Suction
   Refrigerant Hot Gas

3. Refrigerant and Brine Systems:

   Refrigerant Piping

4. Air Distribution Systems:

   Exterior surfaces of all plenums and ducts which are a part of the following systems where duct or plenum is not lined (see Section 230540):
   Outside Air
   Combustion Air
   Mixed Air
   Medium Pressure Supply Air
   Low Pressure Supply Air
   Return Air
   Rigid Round Runouts to Diffusers

5. Other Systems:

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Cold Condensate Drains
Grease Exhaust Duct (shaft alternative)

1.3 QUALITY ASSURANCE

A. Qualifications: The firm executing the work of this Section shall have at least 3 years successful installation experience on projects with mechanical insulations similar in scope and nature to that required for this Project.

B. Requirements of Regulatory Agencies: All insulation shall be in accordance with Jurisdicational Building Code and State and Federal Energy Conservation Standards.

1.4 SUBMITTALS

A. Product Data: Submit manufacturer's specifications and installation instructions for each type of mechanical insulation in accordance with the General Conditions of the Contract. Include schedule showing manufacturer's product number, thickness and furnished accessories for each mechanical system requiring insulation.

B. Provide schedule of pipe sizes with insulation thickness at corresponding fluid temperatures.

1.5 PRODUCT DELIVERY, STORAGE AND HANDLING

A. Delivery of Materials: Deliver insulation, coverings, adhesives, and coatings to site in containers with manufacturer's stamp or label affixed showing fire hazard ratings of products.

B. Storage of Materials: Protect insulation against dirt, water, chemical and mechanical damage. Do not install damaged insulation; remove from project site.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

A. Acceptable manufacturers of insulation materials shall be as follows:

3M/Thermal Ceramics (FireMaster)
Armstrong
Certain-teed
Dow Chemical
Gilsulate International, Inc. (Gilsulate 500XR Loose-Fill Insulation)
Johns Manville
Knauf
Manson Insulation Products
Owens-Corning
Renler (Pyroscat FastR Wrap)
SpecSeal (Claymac)
Unifrax (Fyrewrap)

2.2 MATERIALS

A. Conductivity:

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TYPE OF INSULATION	MAXIMUM THERMAL CONDUCTIVITY/INCH
Calcium Silicate	0.47 at 600 degrees Fahrenheit
Glass Fiber Pipe Insulation	0.25 at 75 degrees Fahrenheit
Glass Fiber Rigid Equipment Insulation	0.25 at 75 degrees Fahrenheit
Glass Fiber Rigid Duct Insulation	0.24 at 75 degrees Fahrenheit
Glass Fiber Blanket Duct Insulation	0.29 at 75 degrees Fahrenheit
Expanded Polystyrene	0.24 at 75 degrees Fahrenheit
Ceramic Fiber Grease Duct Wrap	0.25 at 70 degrees Fahrenheit
Polyisocyanurate Foam	0.19 at 75 degrees Fahrenheit
Granular Loose Fill	See below

B. Duct Board: Rigid glass fiber board with a minimum density of 1-1/2 pounds per cubic foot, a maximum thermal conductivity of 0.24 at 75 deg.F and complying with National Fire Protection Association Pamphlet 90A.

C. Duct Wrap: Blanket-type fiberglass insulation 1-1/2" thick, 0.75 pounds per cubic foot density.

D. Grease Duct Wrap: High-temperature ceramic fiber blanket, foil/scrim encapsulation, max-service temp. = 2300°F. Zero Cleareance duct wrap FyreWrap Elite 1.5, or equal.

E. Vapor Barrier Coatings: To have a perm rating not more than 0.25 when tested in accordance with ASTM E96, procedure A.

F. Adhesives, Sealers, Facings and Vapor Barrier Coatings: To be compatible with materials to which applied, and shall not corrode, soften, or otherwise attack the pipe or insulation materials in either the wet or dry state. Use only adhesives, sealers, facings, and vapor barrier coatings as recommended by the manufacturer of insulation materials.

G. Chemicals for Treating Paper: Non-soluble.

H. Non-Collapsing Inserts: Calcium Silicate or Polyisocyanurate (Dow Trymer 2000). No Polystyrene inserts are allowed.

I. Granular, Loose-Fill Insulation: Inorganic, nontoxic, nonflammable, sodium potassium aluminum silicate with calcium carbonate filler. Include chemical treatment that renders insulation hydrophobic.

1. Thermal Conductivity (k-Value): 0.60 at 175 deg F and 0.65 at 300 deg F.
2. Application Temperature Range: 35 to 800 deg F.
3. Dry Density: 40 to 42 lb/cu. ft.
4. Strength: 12,000 lb/sq. ft.

2.3 PERFORMANCE CRITERIA

A. Insulation and accessory materials to meet the following criteria:

1. Insulation Materials: To be noncombustible as defined in National Fire Protection Association Pamphlet 220 and to be Underwriter's Laboratory listed.
2. Flame/Smoke Ratings: Provide composite mechanical insulation (insulation, jackets, coverings, sealers, mastics and adhesives) with flame-spread rating of 25 or less, and smoke-developed rating of 50 or less, as tested by ANSI/ASTM E 84 (NFPA 255) method.

2.4 HANDICAP LAVATORY INSULATION

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A. Insulation System: Molded closed cell insulation, 3/16-inch nominal wall thickness; provide pre-molded fittings to completely cover tail piece, P-trap, trap arm, hot and cold water supply stop valves and exposed supply tubing; include nylon fasteners for all fittings.

B. Handi Lav-Guard manufactured by Truebro; Trap Wrap manufactured by Brocar Products; Zeston Snap-Trap manufactured by Johns Manville or approved equal.

C. Install at all handicap accessible lavatories installed in this project.

PART 3 - EXECUTION

3.1 GENERAL INSTALLATION REQUIREMENTS

A. Testing of piping and ductwork to be completed prior to application of insulation.

B. Apply insulation tightly over clean, dry surfaces with sections or edges firmly butted together.

C. Make insulation continuous through sleeves or openings in walls and floors.

D. Run sealed vapor barriers continuous throughout all cold surface insulation systems.

E. Avoid the use of staples on vapor barrier jackets. Seal all vapor barrier penetrations with white vapor barrier sealant.

F. Apply adhesives so as not to exceed the coverages recommended by the manufacturers.

G. Leave surfaces clean and ready for painting.

H. Do not insulate cleanouts, access openings or identification plates. Neatly bevel insulation and finishes up to the edges of such openings and stop with sheet metal rings.

I. Provide non-collapsing inserts between pipe and all shields/saddles on all insulated piping 2-1/2" and larger.

3.2 SPECIFIC INSTALLATION REQUIREMENTS

A. Minimum Pipe Insulation Schedule:

2009 International Energy Conservation Code

PIPE INSULATION THICKNESS IN INCHES*			
	Nominal Pipe Diameter		
Fluid	≤ 1.5”	> 1.5”	> 10”
Steam	1.5	3.0	3.0
Hot Water	1.5	2.0	2.0
Chilled Water/Glycol, Chilled Brine, Refrigerant, <Condenser Water Systems used for Indirect Evaporative Cooling>	1.5	1.5	2.0

*Based on insulation having a conductivity not exceeding 0.27 BTU per inch/h·ft^2·°F.

Exceptions:

1. Factory installed piping within HVAC equipment tested and rated in accordance with 2009 IECC referenced procedures.
2. Runout piping not exceeding 4 feet in length and 1 inch in diameter between the control valve and HVAC coil.

DUCT AND PLENUM INSULATION

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Location	Min. Insulation Value
In unconditioned spaces (i.e. ceiling spaces or unheated spaces)	R-5
Outside building envelope	R-8

Exceptions:

a. When located within equipment.
b. When design temperature difference between the interior and exterior of the duct or plenum does not exceed 15°F (i.e. return air ducts in ceiling spaces).

B. Plumbing System:

1. Domestic Cold Water:

Horizontal piping and where freeze protection is required, one-half inch thick fiberglass pipe covering with all service jacket self-seal lap.

All domestic cold (PEX) piping to be insulated to maintain fire/plenum rating where used in air plenums.

2. Roof Drains:

Horizontal mains and vertical from horizontal to and including drain bowls, one-half inch thick fiberglass pipe covering with all service jacket self-seal lap.

Overflow roof drain bowls shall be insulated but not overflow drain piping. Vertical mains shall <not> be insulated.

3. Domestic Hot and Tempered Supply and Circulating Water:

Insulate entire system.
Thicknesses per table of 230700-3.2, A.

4. Domestic Hot Water Heaters, Storage Tanks, and Accumulators (not factory insulated):

Two inch thick fiberglass board, foil faced or faced with Du-All tank wrap or equal. Finish with six-ounce canvas or fiberglass reinforcing mesh and fire retardant lagging adhesive.

5. Domestic Cold Water Storage Tanks:

Two inch thick fiberglass board foil faced or faced with Du-All tank wrap or equal. Seal all joints with vapor barrier mastic. Finish with six-ounce canvas or fiberglass reinforcing mesh and fire retardant vapor barrier mastic.

6. Chilled Drinking Water:

Thicknesses per Chilled Water Piping System, 40-55 deg. F., of 230700-3.2 A.

7. Fittings:

Premolded PVC fitting covers with Fiberglass insert. PVC covers shall be rated for return air plenum use.

8. Valves:

All systems: Oversized pipe covering of same material and thickness as adjacent pipe covering. Finish with six-ounce canvas and heavy coat of vapor barrier mastic coating.

C. Heating System:

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1. Not used

D. Chilling System:

1. Fiberglass pipe covering with all service jacket self-seal lap.

2. Fittings:

   All systems: Premolded PVC fitting covers with fiberglass insert. Seal all fittings at end and throat.

3. Valves:

   All systems: Oversized pipe covering of same material and thickness as adjacent pipe covering. Finish with six-ounce canvas or fiberglass reinforcing mesh and heavy coat of vapor barrier mastic coating.

4. Cold Condensate Drain Piping:

   1/2" thickness fiberglass pipe covering with all service jacket self-seal lap.

5. Refrigerant Suction and Liquid Piping: Thicknesses per Refrigerant Piping System of Section 230700 - 3.2, A.

   Fiberglass pipe covering with all service jacket self-seal lap. <At Contractor's Option, a closed cell insulation with all joints butted and cemented may be used in lieu of fiberglass. Armaflex 22 or equal. If closed cell insulation is exposed to sunlight, coat all surfaces with UV protection to prevent long term deterioration from sunlight.>

6. Refrigerant Hot Gas Piping:

   1" thickness fiberglass pipe covering with all service jacket self-seal lap, or 3/4" thick closed cell insulation. This is for safety purposes only, not for thermal efficiency.

E. Buried Piping:

1. Do not disturb the bottom of trench, or compact and stabilize it to ensure proper support.
2. Remove any standing water in the bottom of trench.
3. Form insulation trench by excavation or by installing drywall side forms to establish required height and width of the insulation.
4. Support piping with proper pitch, separation, and clearance to backfill or side forms using temporary supporting devices that can be removed after back filling with insulation.
5. Place insulation and backfill after field quality-control testing has been completed and results approved.
6. Apply bitumastic coating to carbon-steel anchors and guides. Pour concrete thrust blocks and anchors.
7. Wrap piping at bends, expansion loops, and offsets with mineral-wool insulation of thickness appropriate for calculated expansion amount.
8. Pour loose-fill insulation to required dimension agitating insulation to eliminate voids around piping.
9. Remove temporary hangers and supports.
10. Cover loose-fill insulation with polyethylene sheet a minimum of 4 mils (0.10 mm) thick, and empty loose-fill insulation bags on top.
11. Manually backfill 6 inches (150 mm) of clean backfill. If mechanical compaction is required, manually backfill to 12 inches (300 mm) before using mechanical-compaction equipment.

F. Refrigerant System:

1. Expanded polystyrene pipe covering with all service jacket and self-seal lap.

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2. Refrigerant piping and brine piping: Insulate with thickness per Section 230700-3.2, A. Thickness over 2-1/2 inch may be applied in two layers. Ends of inner layer sections shall be staggered and taped. End and longitudinal joints of outer layer shall be staggered with inner layer joints. Secure with 1-inch fiberglass filament tape 12 inches on center. Provide factory applied all service jacket on outer layer. Seal all ends of insulation runs.
3. Valves and Fittings: Pre-molded covers fabricated of same material and thickness as pipe insulation. Fill gaps with injected foam insulation. Secure covers with 1 inch fiberglass filament tape.
4. Vessels: Insulate with two layers of prefabricated curved segments to fit vessel. Stagger all joints. Secure with banding 18 inches on center. Extend side insulation past tank head to thickness of insulation, insert circular end insulation. Fill voids with injected foam insulation.
5. Brine pumps: Pumps shall be insulated with 2-inch total thickness of flexible expanded elastomeric insulation, install to allow for maintenance access to pump.

G. Air Distribution System:

1. Exterior surfaces of outside air, combustion air, mixed air, and recovery coil discharge:

   One and one-half inch thick fiberglass three pound board with all service jacket. Seal all joints and pins with tape material to match jacket. Apply material with weld pins or stick clips.

2. Exterior surfaces of supply and return air plenums where not indicated to be lined:

   One and one-half inch thick fiberglass three pound board with all service jacket. Seal all joints and pins with tape material to match jacket. Apply material with weld pins.

3. Exterior surfaces of exposed supply ductwork not lined:

   One and one-half inch thick fiberglass three pound board with all service jacket. Seal all joints and pins with tape material to match jacket. Apply material with weld pins or stick clips.

4. Concealed supply ductwork not lined:

   One and one-half inch thick 0.75 pound fiberglass duct wrap with foil scrim facings. All joints sealed. Apply material with adhesive or wire 18 inches o.c.

5. Low pressure round runouts to diffusers:

   One and one-half inch thick 0.75 pound fiberglass duct wrap with foil scrim facings. All joints sealed. Apply material with adhesive or wire 18 inches o.c.

6. See Specification Section 230540 – Mechanical Sound and Vibration Control for requirements for lined ductwork.

H. Other Systems:

1. Piping Exposed to Freezing with Heat Tracer:

   One-inch thick fiberglass pipe covering with all service jacket-self seal lap. Finish with 0.016-inch thick corrugated aluminum jacket and fitting covers for protection.

   NOTE: Insulation shall be applied over heat tracer.

2. Piping Insulation Exposed to Rainfall:

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Provide 0.016-inch thick corrugated aluminum jacket and fitting covers on all insulation exposed to rainfall. Install seam on bottom of horizontal and angled piping. Seal all joints weather-tight. Seal jacket seams with silicone sealant.

3. Protective Insulation Jacketing:

   Provide high impact polyvinyl chloride pipe covering on insulated piping. Thickness to be 30 mil. Install where noted on drawings and per manufacturer's recommendations for hot and cold piping systems. Seal using solvent welding adhesive, providing slip joints as required for expansion and contraction. Ceel-Co Ceel-Tite 300 series, Schuller Zeston 300 series, or approved equal.

4. Grease Duct (Shaft Alternative):

   One and one-half inch thick ceramic fiber duct wrap meeting ASTM E 119 performance standard from top of hood to roof/wall penetration. Apply in accordance with manufacturer’s instructions. Provide two layers of duct wrap as alternative to rated shaft. Secure with 3/4" stainless steel banding. Provide insulated covers at grease duct access doors and cleanouts.

5. Condensate Drains Inside Buildings:

   1/2" thickness fiberglass pipe covering with all service jacket self-seal lap.

END OF SECTION 23 07 00

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SECTION 23 11 23 - NATURAL GAS SYSTEM

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Pipe and Fittings.

B. Gas Safety Valve (Kitchen).

C. Gas Meter.

D. Gas Pressure Regulator.

1.2 RELATED REQUIREMENTS

A. The General Conditions, Supplementary Conditions and Division 1, General Requirements apply to this Section, and Contractor shall review and adhere to all requirements of these documents.

B. Section 230500 - Basic Mechanical Requirements.

1.3 RELATED SECTIONS

A. Section 230529- Basic Mechanical Materials and Methods: Valves, pipe hangers, supports and accessories.

B. Section 230548 - Mechanical Seismic Control.

C. Section 224450 - Plumbing Equipment: Gas supply and runout with gas cock or valve to water heater connection points.

D. Section 224460 - Special Plumbing Equipment Systems: Gas supply and runout with gas cock or valve to connection points on all kitchen and laboratory equipment, headers or modules.

E. Section 237400 - Air Handling Systems on Roof: Gas supply and runout with gas cock or valve to rooftop packaged air handler connection points.

1.4 REFERENCES

A. NFPA 54 (ANSI Z223.1) - National Fuel Gas Code.

B. ANSI Z223.1a - Supplement to National Fuel Gas Code.

1.5 DEFINITIONS

A. The following are references with definition acronyms used in this section:

1. U.L. - Underwriters Laboratory Listed for Fire Protection Systems.
2. F.M. - Factory Mutual Engineering Division.
3. IRI - Industrial Risk Insurors AKA: F.I.A. Factory Insurance Association.
4. Jurisdictional Agencies:

    a. Building Department.
    b. Fire Department or Fire Prevention Bureau or Marshal.
    c. Insurance Agency, Carrier, and/or Underwriter.
    d. Engineer refers to the consulting Mechanical Engineer of record.

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1.6 SYSTEM DESCRIPTION

A. Provide gas supply from gas meter outlet to all gas consuming equipment complete with piping, meters, valves, unions, dirt legs, hangers, supports, anchors, expansion compensators and regulators.

1.7 QUALITY ASSURANCE

A. Welding: Welders shall be certified in accordance with requirements in Section 230529.

1.8 REGULATORY REQUIREMENTS

A. Conform to Regulatory Requirements listed in Section 230500.

B. Provide special inspections required in IBC Chapter 17.

1.9 SUBMITTALS

A. Submit Product Data for the following items under provisions of the General Conditions of the Contract:

1. Pipe, fittings, valves, hangers and supports.
2. Gas solenoid valves, cabinets and controls.
3. Regulators.

B. Submit printed Operating Instructions and Maintenance Data for the following items under provisions of Operating and Maintenance Data paragraph in Section 230500:

1. Gas solenoid valves and controls.
2. Regulators.
3. Valves.

C. Submit certified test reports, dated and signed by authorized person showing compliance of tests of the fuel gas systems, in accordance with the Contract Documents.

1.10 SEQUENCING/SCHEDULING

A. Coordinate all work with all other trades and utility companies for elimination of interference, utilization of combined hanger support systems, timely routing and installation of systems, verifications of existing connector utilities, locations, depths, connection regulation, proper valving and junction structures or fittings. Location of meters, and remote readers as applicable and appropriate.

1.11 WARRANTIES

A. Provide original copies of all warranties for specific equipment where specified and in accordance with Section 230500.

B. Provide 20 year full warranty on all cathodic protection and pipe wrapping against corrosion of piping due to electrolytic or active soil conditions.

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1.12 GAS SERVICE

A. Arrange with Utility Company to provide gas service to indicated location with shut-off at terminus. Consult with Utility as to extent of its work, costs, fees and permits involved. 231123 Contractor shall pay such costs and fees; obtain permits.

PART 2 - PRODUCTS

2.1 PIPE AND FITTINGS

A. Buried Exterior (meter and building service):

1. Pipe: Schedule 40 Black Steel ASTM A-53 pipe for butt welding or plastic piping as defined below when acceptable jurisdictional authorities.
2. Fittings: Butt weld steel, ASTM-234.
3. Wrapping: Scotchwrap 10 mil PVC tape or Standard of serving Utility Company.
4. Contractor's Options, when acceptable to jurisdictional authorities:

   a. Natural Gas:

      1) High Density Polyethylene pipe and fittings; ASTM D-3350:335434C, PPI:PE 3408/3406, Type III, Grade P34 Category 5 per ASTM D 1248, SDR 11 pipe.

      2) Polyvinylchloride natural gas pipe and fittings:

         Size 1/2" thru 1-1/2": Sch. 40 Type 1 PVC 1120, IAPMO: 15-10-71, ASTM D 1785.

         Size 2" thru 6": Class 315 Type 1 PVC 1120, IAPMO: 15-10-71, ASTM D 2513.

B. Interior Exposed or Accessible:

1. Size 1/2" thru 1-1/2":

   Pipe: Schedule 40, ASTM A 53
   Fittings: Threaded malleable iron
   Joint Seal: Teflon
   Unions: Black malleable iron ground joint, bronze to iron seat, 150 lb. class, ANSI B2.1 and ASTM A 197.

2. Size 2" and over:

   Pipe: Schedule 40, ASTM A53, Type S Grade B
   Fittings: Butt weld ASTM A 234
   Unions: 150 lb. forged steel weld neck flange, ANSI B16.5 and ASTM A105.

C. Interior, concealed, non-accessible spaces and return air plenums:

Use no unions, tubing fittings, right or left couplings, bushing, shut-off valves, compression coupling, or swing joints made by combinations of fittings.

2.2 GAS SAFETY VALVE (KITCHEN)

A. Manufacturer:

1. Automatic Switch Co. (ASCO) Series 8044 valves.

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B. Operation Requirement:

1. Operating differential: 0 psi
2. 120 volt, 60 hertz, 1 phase
3. Coil insulation Class F
4. Coil watt rating: 16.7 watts, all sizes
5. Latched open when energized, free handle design, manual reset, and visual position indicator

C. Control shall be as described in Part 3 - Execution of this Section.

D. Based on 1000 Btu/CF calorific valve of gas. Correction to actual calorific value at installation site must be calculated for proper valve size application.

2.3 GAS METER

A. As provided by utility company.

2.4 GAS PRESSURE REGULATOR

A. General: Provide single stage, steel jacketed, corrosion-resistant gas pressure regulators with atmospheric vent, elevation compensator; with threaded ends for 2" and smaller, flanged ends for 2-1/2" and larger; for inlet and outlet gas pressures, specific gravity, and volume flow required.

B. Provide vent-limited or vented gas pressure regulators as required by appliance served. Vented regulators shall be piped to vent to outdoors per jurisdictional requirements.

PART 3 - EXECUTION

3.1 GENERAL

A. Welding, wiring, sleeves, plates and closures, foundations and pads, excavation and backfill, cutting and patching and installation of piping, valves, pipe hangers, supports, expansion compensators and identification shall be in accordance with Section 230529 - Basic Mechanical Materials and Methods.

B. Provide all fuel gas piping from source to each connection point of all gas fired equipment items listed in "Related Work" paragraph in Part 1. Provide drip leg and gas cock or valve for each equipment item. Make final connections in compliance with equipment manufacturer's instructions. Flexible connections will not be allowed except where explicitly specified.

3.2 PIPING

A. General:

1. Install fuel gas distribution piping in accordance with jurisdiction codes and local Utility Company requirements and in conformity with standards listed in "References" paragraph in Part 1.
2. Install "Tee" fitting with bottom outlet fitted with full size 6" long nipple and capped, at bottom of pipe risers or drops.
3. Use dielectric unions where dissimilar metals are joined together.
4. Use Teflon joint seal on metal gas piping threads, make up with 3 threads showing.
5. Remove cutting and threading burrs before assembling piping.
6. Do not install defective piping or fittings. Do not use pipe with threads which are chipped, stripped or damaged.
7. Plug each gas outlet, including valves, with threaded plug or cap immediately after installation and retain until continuing piping, or equipment connections are completed.

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8. Connections to all gas-fired equipment shall include a union downstream of the manual gas shut-off valve.
9. For buried piping outside of building walls, piping shall rise out of ground 12” before penetrating building wall.
10. Provide exterior gas piping and fittings with primed and painted surface. Coordinate color with Owner, Architect, and authority having jurisdiction.

B. Buried Piping: Welded and wrapped with joints left exposed until testing has been accepted. Bury 24" below grade minimum.

C. Wrapping:

1. Provide factory applied pipe wrap in accordance with standard of serving utility company. Hand wrap or machine wrap buried exterior gas piping with Scotchwrap 10 mil PVC tape using 50% overlap wrap minimum. Double wrap fittings and joints. Extend fitting wrapping not less than 6 inches past the end of the fitting onto the pipe section. Test pipe and fittings prior to wrapping fittings. Coat steel and iron pipe with Scotchwrap pipe primer before wrapping.

2. Pipe wrapping shall conform to the following schedule:

Pipe Size	Tape Width	Scotchwrap No.	
		Standard	Cold
¼ - ¾ inch	1 inch	50	40
1 - 1-1/2 inch	2 or 4 inch	50	40
2 inch and larger	4 inch	50	40
Color Backing		Black	Green

3. During application of wrap, if the ambient temperature is 40 deg.F or less, use only Scotchwrap No. 40 tape. If ambient temperature is 41 deg.F or more, use only Scotchwrap No. 50.

D. Buried Pipe Identification: Install bright colored continuously printed plastic ribbon tape of not less than 6 inches width and 4 mil thickness 6 to 8 inches below finished grade directly over buried pipe. Provide metalized tape over non-metallic pipe.

E. Interior Concealed Piping: All pipe and fittings shall be welded. Do not install valves of any type in air plenums or concealed spaces.

3.3 HANGERS AND SUPPORT SYSTEMS (Interior)

A. Provide pipe hangers, supports and accessories in accordance with Section 230529 - Basic Mechanical Materials and Methods.

3.4 ROOF SUPPORTS AND ANCHORS

A. Approved Manufacturers: Miro, Mapa.

B. Provide pipe supports spaced per Hanger Specifications in Section 230529 - Basic Mechanical Materials and Methods. Provide pipe straps to anchor pipe to supports.

C. Provide pipe expansion loops as shown and required to eliminate pipe stress due to thermal expansion imposed by solar influence.

D. See details on Drawings.

3.5 VALVES

A. Provide valves in accordance with Section 230529 - Basic Mechanical Materials and Methods.

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3.6 GAS SOLENOID VALVES

A. General:

1. Valves shall be mounted with solenoid valve stem in the vertical upright position only.
2. Valves shall be installed in wall boxes unless specifically defined to be in exposed location by the Contract Documents.
3. Valves shall be installed with unions, or other means to provide removal or repair without disassembly of connecting piping or of cabinet.
4. Provide electric wiring in accordance with Section 230529 - Basic Mechanical Materials and Methods.
5. Provide neoprene grommets for all piping and electrical conduit entering and exiting cabinets.

B. GSV Valves:

1. Control panels and wall cabinets mounted 5'-0" from floor to centerline.
2. Provide necessary interlocks, relays, wiring and installation for valve operation in conjunction with fire suppression systems as follows:

    a. Valve shall be de-energized when fire suppression system is activated.
    b. Reset of valve only possible after the fire suppression system has been reset, recharged and in "ready" mode.

3.7 GAS COCKS AND GAS VALVES

A. Provide at supply runout connection for each gas-fired equipment item; and on risers and branches where indicated.

B. Locate gas cocks and valves where easily accessible, and where they will be protected from possible damage.

3.8 GAS SERVICE

A. Complete arrangements with Utility Company to provide gas service to indicated location with shut-off at terminus.

B. Extend service pipe from Utility's terminus to inside building wall, under Utility's direction.

C. Provide shut-off outside building where indicated, in adjustable gas service valve box, with cover set flush to finished grade.

3.9 GAS METER

A. Be responsible to verify with utility company the size and thickness, reinforcing and location of all concrete pads, chain link enclosures, gate requirements, bar-hasp-padlock requirements, and size and type of traffic bollards-guards required.

B. Provide concrete pad in accordance with Section 230529 - Basic Mechanical Materials and Methods.

C. Provide enclosures, bumper protection or other accessories which may be required.

D. Install gas meter in accordance with local Utility Company's installation instructions and comply with requirements of jurisdictional codes.

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3.10 GAS PRESSURE REGULATOR

A. Install as indicated; comply with Utility requirements. Pipe atmospheric vent to outdoors (unless a vent-limited regulator is used), full size of outlet. Install gas shut-off valve upstream of each pressure regulating valve.

3.11 TESTS

A. General: Test fuel supply lines with air under pressure before being covered. Use a calibrated, certified static gauge graduated to one pound per square inch.

B. Testing shall be of the complete piping system, before covering, or of individually separable larger portions of the system. Only the last connection to the appliance may be tested under operating conditions. This connection will be tested with soap and brush under line pressures. This connection must remain exposed.

C. Test Procedures: Use either of the following methods at the Contractor's option:

1. 30 psig air pressure for a period of 24 hours with no drop in gauge pressure, indicating the line to be airtight.
2. 100 psig air pressure, with joints tested with standard soap and brush inspection and maintain for 3 hours without drop in pressure.

D. Retesting: Retest piping failing initial tests following correction of defective work. Requirements of initial tests shall apply.

E. Test Records: Record pressure and ambient temperature at start and end of test. Submit written results of test to the Architect/Engineer.

END OF SECTION 23 11 23

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Community School

SECTION 23 33 00 - DUCTWORK AND ACCESSORIES

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Low pressure ductwork.

B. Manufactured duct joints.

C. Casings.

D. Kitchen hood exhaust ductwork.

E. Damper operator hardware.

F. Volume control dampers.

G. Fire dampers.

H. Combination fire and smoke dampers.

I. Combination fire, smoke, and control dampers.

J. Smoke dampers.

K. Gravity backdraft dampers.

L. Motorized backdraft dampers.

M. Insulated flexible round ductwork.

N. Flexible duct fan connections.

O. Access door hardware.

P. Duct access doors.

1.2 RELATED REQUIREMENTS

A. The General Conditions, Supplementary Conditions and Division 1, General Requirements apply to this Section, and Contractor shall review and adhere to all requirements of these documents.

B. Section 230500 - Basic Mechanical Requirements.

1.3 RELATED SECTIONS

A. Section 230529 - Basic Mechanical Material and Methods.

B. Section 230540 - Mechanical, Sound and Vibration Control.

C. Section 230548 – Mechanical Seismic Control.

D. Section 230593 - Testing, Adjusting and Balancing.

E. Section 230700 - Mechanical Insulation.

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F. Section 230900 - Electronic Controls.

1.4 REFERENCES AND CODE REQUIREMENTS

A. ASHRAE - Handbook 2009 Fundamentals; Chapter 21 - Duct Design.

B. ASHRAE - Handbook 2008 HVAC Systems and Equipment; Chapter 18 - Duct Construction.

C. ASTM A90 - Weight of Coating on Zinc-Coated (Galvanized) Iron or Steel Articles.

D. ASTM A167 - Stainless and Heat-Resisting Chromium-Nickel Steel Plate, Sheet, and Strip.

E. ASTM A525 - General Requirements for Steel Sheet, Zinc-Coated (Galvanized) by the Hot-Dip Process.

F. ASTM A527 - Steel Sheet, Zinc-Coated (Galvanized) by Hot-Dip Process, Lock Forming Quality.

G. ASTM B209 - Aluminum and Aluminum Alloy Sheet and Plate.

H. ASTM C14 - Concrete Sewer, Storm Drain, and Culvert Pipe.

I. ASTM C443 - Joints for Circular Concrete Sewer and Culvert Pipe, Using Rubber Gaskets.

J. NFPA 90A - Installation of Air Conditioning and Ventilating Systems.

K. NFPA 90B - Installation of Warm Air Heating and Air Conditioning Systems.
NFPA 92A - Smoke Control Systems.
NFPA 92B - Smoke Management Systems.

L. NFPA 96 - Installation of Equipment for the Removal of Smoke and Grease-Laden Vapors from Commercial Cooking Equipment.

M. SMACNA - HVAC Duct Construction Standards.

N. SMACNA - HVAC Air Duct Leakage Test Manual

O. SMACNA - Fibrous Glass Duct Construction Standards.

P. UL 33 - Heat Responsive Links for Fire-Protection Service.

Q. UL 181 - Factory-Made Air Ducts and Connectors.

R. UL 555 - Fire Dampers and Ceiling Dampers.
UL 555S - Leakage Rated Dampers for Smoke Control Systems.

1.5 DEFINITIONS

A. Duct Sizes: Inside clear dimensions. For lined ducts, maintain sizes inside lining.

B. Low Pressure: Design and Construct to SMACNA 2 in. w.g. pressure class. Low pressure duct shall include: Supply duct downstream of VAV boxes, return duct, general/toilet exhaust ducts, fresh air duct, relief duct, smoke exhaust duct and combustion air duct, unless otherwise indicated on drawings.

1.6 REGULATORY REQUIREMENTS

A. Construct ductwork to NFPA 90A standards.

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1.7 SUBMITTALS

A. Submit Shop Drawings for the following items under provision of The General Conditions of the Contract:

1. Shop fabricated assemblies including duct or plenum access doors.

2. Duct fittings, particulars such as gauges, sizes, weld, and configuration prior to start of work for low pressure kitchen hood exhaust systems.

B. Submit Product Data for the following items under provision of The General Conditions of the Contract:

1. Combination fire and smoke dampers.
2. Backdraft dampers.

C. Submit printed Operating Instructions and Maintenance Data for the following items under provisions of Operating and Maintenance Data paragraph in Section 230500:

1. Combination Fire and Smoke Dampers.

1.8 PROJECT CONDITIONS

A. Contractor shall not fabricate or install any ductwork until he has assured himself that the ductwork can be run as contemplated in cooperation with Contractors of other Divisions of the Work and the physical constraints of the Structural and Architectural Work.

B. Contractor shall prepare 1/4" = 1'-0" scale shop drawings of all ductwork and plenums within confines of mechanical rooms and hallways for coordination with other trades and the Architectural and structural work.

C. Provide any and all off-sets and fittings required to coordinate with field conditions. The lack of coordination will not constitute a change in contract price. The contract drawings are of a schematic nature only, exact duct routing and field coordination is the responsibility of the Division 233300 Contractor.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Nonmetallic air ducts and connectors shall conform to UL 181 Class 0 or Class 1.

B. Steel Ducts: ASTM A525 and ASTM A527 galvanized steel sheet, lock-forming quality, having G90 zinc coating each side in conformance with ASTM A90.

C. Aluminum Ducts: ANSI/ASTM B209; aluminum sheet, alloy 3003-H14. Aluminum Connectors and Bar Stock: Alloy 6061-T6 or of equivalent strength.

D. Stainless Steel Ducts: ASTM A167.

E. Fasteners: Rivets, bolts, or sheet metal screws.

F. Sealant: Non-hardening, water resistant, fire resistive, compatible with mating materials; liquid used alone or with tape, or heavy mastic.

G. Hanger Rod: Steel, galvanized; threaded both ends, threaded one end, or all thread.

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2.2 LOW PRESSURE DUCTWORK

A. Fabricate and support in accordance with SMACNA HVAC Duct Construction Standards and ASHRAE handbooks, except as indicated. Provide duct material, gauges, reinforcing, and sealing for operating pressures specified or as indicated on drawings.

B. Construct T's, bends, and elbows with radius of not less than 1-1/2 times width of duct on centerline. Where not possible and where rectangular elbows are used, provide turning vanes. Where acoustical lining is indicated, provide turning vanes of perforated metal with glass fiber insulation.

C. Construct fittings with 45 degree wye or 90 degree wye with 45 degree entry.

D. Round take-offs shall be plain spin collar fittings of 90 degrees unless indicated otherwise on drawings. Round spin collar fittings serving low-pressure duct run-outs to diffusers and grilles may include damper blade with two quadrants, fully retractable zinc alloy bearings, washers, and position handle with wing nut to lock damper position. Include 2-inch position handle standoff where used on externally insulated ducts.

E. Increase duct sizes gradually, not exceeding 15 degrees divergence wherever possible. Divergence upstream of equipment shall not exceed 30 degrees; convergence downstream shall not exceed 45 degrees.

F. Provide easements where low pressure ductwork conflicts with piping and structure. Where easements exceed 10 percent duct area, split into two ducts maintaining original duct area.

G. Use crimp joints with or without bead for joining round duct sizes 8 inch and smaller with crimp in direction of airflow.

2.3 MANUFACTURED DUCT JOINTS

A. Manufacturer: Ductmate Industries, Inc., TDF, MEZ Industries, Hercules.

B. Transverse duct joints of medium pressure ductwork shall be made with the Ductmate System components of standard catalog manufacture.

2.4 KITCHEN HOOD EXHAUST DUCTWORK

A. Fabricate in accordance with SMACNA HVAC Duct Construction Standards and NFPA 96.

B. Construct of 18 gauge Type 304 stainless steel using continuous external liquid-tight welded joints and seams.

2.5 DAMPER OPERATOR HARDWARE

A. Manufacturers: Ventfabrics Ventlok Regulators, Metropolitan Air.

B. Other acceptable manufacturers offering equivalent product: Duro Dyne, Daniel.

C. Regulators and End Bearings.

Damper shaft length:
12" or less - Ventlok #620 Regulator.
12" to 20" - Ventlok #635 Regulator and #607 Bearings.
Larger dampers - Ventlok #640 or #641 Regulator and #607 Bearings.

D. Provide equivalent model elevated bases for insulated ducts.

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E. Provide remote damper control where any damper does not have permanent access. System to include a locking worm drive gear, ¼" flexible steel shaft and a concealed ceiling cap of 1". Manufacturers: Young Regulator, Price, or approved equal.

2.6 VOLUME CONTROL DAMPERS

A. Fabricate in accordance with SMACNA HVAC Duct Construction Standards, and as indicated.

B. Fabricate single blade dampers for duct sizes to 9-1/2 x 30 inch.

C. Fabricate multi-blade damper of opposed blade pattern with maximum blade sizes 6 x 72 inch. Assemble center and edge crimped blades in prime coated or galvanized channel frame with suitable hardware.

D. Except in round ductwork 12 inches and smaller, provide end bearings. On multiple blade dampers, provide oil-impregnated nylon or sintered bronze bearings.

E. Provide locking, indicating quadrant regulators on single and multi-blade dampers.

F. On insulated ducts, mount quadrant regulators on stand-off mounting brackets, bases, or adapters.

G. Specification for low-pressure spin collar fittings with integral balancing dampers is found in paragraph 2.2.

2.7 FIRE DAMPERS FOR STATIC SYSTEMS (NON HIGH-RISE BUILDINGS)

(All building supply and exhaust fans shut down upon fire and/or smoke alarm)

A. Acceptable manufacturers: Meet UL-555 requirements.

B. Furnish and install, where plans show square or rectangular fire wall penetrations, fire dampers constructed and tested in accordance with the current edition of UL-555, Standard For Fire Dampers. Each fire damper shall be marked with a UL classified 1-1/2 hour fire protection rating and "for use in static systems only." In addition each fire damper shall include a 165°F fusible link. Fire dampers shall have damper blades out of air stream for minimum airflow restriction. Fire dampers shall include a factory fabricated steel sleeve with 12" or 22" two piece picture frame mounting angles factory supplied and shipped on each damper to ensure appropriate installation. Submittal information shall include the fire protection rating and the manufacturer's UL installation instructions. The dampers shall be installed in accordance with manufacturer's instructions shipped with the damper. Fire dampers shall be equivalent to Ruskin model IBD2 "B" Style.

C. Where plans show round or oval fire wall penetrations, furnish and install fire dampers as described above except that fire damper shall have damper frame and blades completely out of air stream for minimum air flow restriction. Damper shall include a factory fabricated fully welded and sealed steel sleeve with 12" or 22" two piece picture frame mounting angles factory supplied and shipped on each damper to ensure appropriate installation. Submittal information shall include the fire protection rating and the manufacturer's UL installation instructions. The dampers shall be installed in accordance with these instructions. Fire dampers shall be equivalent to Ruskin model IBD2 "CR" or "CO" Style.

D. Ducts connecting to sleeves shall be equal to or less than the sleeve thickness. Sleeve gauge requirements are listed in the SMACNA Fire, Smoke and Radiation Damper Installation Guide and outlined in NFPA 90A. If any other duct to sleeve connections are used, sleeve shall be 16 ga. minimum for dampers up 36"x24", and 14 ga. if damper width exceeds 36" or damper height exceeds 24".

E. Where job conditions require vertical dampers larger than manufacturer's maximum UL tested sizes, contractor will provide and install fire rated mullions in accordance with fire damper manufacturer's instructions.

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F. Where duct gauges allow their use, contractor may, at his option, install square or rectangular fire dampers with 12, 14, 16" long integral roll-formed steel sleeves. Retaining angles shall be furnished by the damper manufacturer to ensure appropriate installation. Submittal information shall include the fire protection rating and the manufacturer's UL installation instructions. Each fire damper shipment shall include the same UL installation instructions and the dampers shall be installed in accordance with these instructions. Fire dampers shall be Ruskin model IBD20, IBD40, or IBD60 "B" Style. Where round or oval duct gauges allow their use, contractor may, at his option, install round or oval fire dampers with 12, 14, 16" long integral roll-formed steel sleeves. Installation shall be as described above. Sleeves shall be factory sealed airtight. Fire dampers shall be equivalent to Ruskin model IBD20, IBD40, or IBD60 Style "LR" or "LO."

G. Contractor may, with engineer's approval, use certain models of dampers that afford ease of installation and labor savings such as dampers designed for grills, dampers with S-and-Drivemate breakaway connections, or dampers designed for metal stud wall applications. Install as described above per the manufacturer's UL installation instructions.

2.8 SMOKE DAMPERS FOR STATIC SYSTEMS (NON HIGH-RISE BUILDINGS)
(All building supply and exhaust fans shut down upon fire and/or smoke alarm)

A. Acceptable manufacturers: Meet UL 555S requirements.

B. Furnish and install at locations shown on plans, or as described in schedules, Ruskin model SD-60 or equivalent smoke dampers meeting or exceeding the following specifications. Frame shall be a minimum of 16 gauge galvanized steel formed into a structural hat channel reinforced at corners for added strength. The blades shall be airfoil shaped double skin construction with 14 gauge equivalent thickness. Non-airfoil blade shapes are not allowed. Blade action shall be opposed. Bearings shall be stainless steel sleeve turning in an extruded hole in the frame. Galvanized or synthetic bearings are not be acceptable. Blade edge seals shall be silicone rubber and galvanized steel mechanically locked into blade edge and shall withstand a minimum of 450°F. Adhesive or clip fastened seals are not acceptable. Jamb seals shall be non-corrosive stainless steel flexible metal compression type.

C. Each smoke damper shall be classified by Underwriters Laboratories as a Leakage Rated Damper for use in smoke control systems in accordance with the latest version of UL555S, and bear a UL label attesting to the same. Damper manufacturer shall have tested, and qualified with UL, a complete range of damper sizes covering all dampers required by this specification. Testing and UL qualifying a single damper size is not acceptable. The leakage rating under UL555S shall be leakage Class I (4 cfm/sq. ft. at 1" w.g. and 8 cfm/sq. ft. at 4" w.g.). As part of the UL qualification, dampers shall have demonstrated a capacity to operate (to open and close) under HVAC system operating conditions, with pressures of at least 4" w.g. in the closed position, and up to 4,000 fpm air velocity in the open position.

D. Each smoke damper shall be equipped with a factory supplied and mounted 120 v electric actuator to close the smoke damper during test, smoke detection, power failure.

2.9 CORRIDOR FIRE/SMOKE DAMPERS

A. Acceptable manufacturers: Meet UL requirements for a "Corridor Damper."

B. Where tunnel corridor penetrations are square or rectangular, furnish and install at locations shown on the plans or as described in schedules, corridor dampers meeting or exceeding the following specification:

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C. Frame shall be a minimum of 16 gauge galvanized steel formed into a structural hat channel and shall be low profile high performance type for lowest pressure drop. The blades shall be single skin galvanized steel 16 gauge minimum with three longitudinal grooves for reinforcement. Bearings shall be stainless steel turning in an extruded hole in frame. (Galvanized or synthetic bearings shall not be acceptable.) Blade edge seals shall be inflatable silicone coated fiberglass material to insure tight seal and low leakage. Seals shall be mechanically locked into blade edge (adhesive or clip fastened seals not acceptable) and shall withstand a minimum of 450°F. Jamb seals shall be non-corrosive stainless steel flexible metal compression type.

D. Each damper shall be listed as a fire damper and leakage (smoke) damper and classified by Underwriters Laboratories as a "Corridor Damper" for installation in tunnel corridors. They shall be rated for 1 hour fire resistance under UL555 and shall have a minimum leakage rating of Class II under UL555S for use in smoke control systems. Each damper shall bear a UL label designating the damper as "Corridor Damper."

E. In addition to the leakage ratings already specified herein, the dampers and their non-stall type actuators shall be qualified under UL555S to an elevated temperature of 350°F. Appropriate 120v electric actuators shall be installed by the damper manufacturer at time of damper fabrication. Stall type and instantaneous close type actuators not acceptable. Damper and actuator shall be supplied as a single entity meeting all applicable UL555 and UL555S qualifications for both dampers and actuators.

F. Damper manufacturer shall provide factory assembled minimum 20 gauge steel sleeve. Damper shall be sealed to the sleeve with a 25/50 flame spread/smoke developed sealant material.

G. Each corridor damper shall be equipped with a controlled 7 to 15 second heat-actuated release device. The electric EFL shall close and lock the fire/smoke damper during test, smoke detection, power failure or fire conditions through actuator closure springs. To prevent duct and HVAC component damage, the damper shall at all times be connected to the actuator for controlled closure in not less than 7 seconds and no more than 15 seconds. Instantaneous damper closure is unacceptable. Damper shall be automatic remote resettable after test, smoke detection or power failure conditions. After exposure to high temperature or fire, the damper must be inspected prior to reset to ensure proper operation. Release temperatures are 165°F. 1 hour dampers shall be Ruskin model FSD36C or equivalent.

H. Where tunnel corridors use round neck diffusers, furnish and install round combination fire/smoke dampers for ceiling penetration of tunnel corridors complete with integral surface mounted ceiling diffusers, Ruskin model DFSDR or equivalent. Operation shall be the same as described above.

2.10 FIRE/SMOKE DAMPERS FOR STATIC SYSTEMS (NON HIGH-RISE BUILDINGS)
(All building supply and exhaust fans shut down upon fire and/or smoke alarm)

A. Acceptable manufacturers: Meet UL-555S requirements.

B. Furnish and install at locations shown on plans, or as described in schedules, combination fire/smoke dampers meeting or exceeding the following specifications. Frame shall be a minimum of 16 gauge galvanized steel formed into a structural hat channel reinforced at corners for added strength. The blades shall be airfoil shaped double skin construction with 14 gauge equivalent thickness. Non-airfoil blade shapes are not allowed. Blade action shall be opposed. Bearings shall be stainless steel sleeve turning in an extruded hole in the frame. Galvanized or synthetic bearings are not be acceptable. Blade edge seals shall be silicone rubber and galvanized steel mechanically locked into blade edge and shall withstand a minimum of 450°F. Adhesive or clip fastened seals are not acceptable. Jamb seals shall be non-corrosive stainless steel flexible metal compression type.

C. Each combination fire/smoke damper shall be classified 1-1/2 hour for use in fire resistance ratings of less than 3 hours or 3 hour for use for fire resistance ratings of 3 hours or more. They shall be in accordance with UL standard 555, and shall further be classified by Underwriters Laboratories as a Leakage Rated Damper for use in smoke control systems in accordance with the latest version of UL555S, and bear a UL label attesting to the same. Damper manufacturer shall have tested, and

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qualified with UL, a complete range of damper sizes covering all dampers required by this specification. Testing and UL qualifying a single damper size is not acceptable. The leakage rating under UL555S shall be leakage Class I (4 cfm/sq. ft. at 1" w.g. and 8 cfm/sq. ft. at 4" w.g.). As part of the UL qualification, dampers shall have demonstrated a capacity to operate (to open and close) under HVAC system operating conditions, with pressures of at least 4" w.g. in the closed position, and up to 4,000 fpm air velocity in the open position.

D. In addition to the leakage ratings already specified herein, the dampers and their non-stall type actuators shall be qualified under UL555S to an elevated temperature of 350°F. Appropriate 120v electric actuators shall be installed by the damper manufacturer at time of damper fabrication. Stall type and instantaneous close type actuators not acceptable. Damper and actuator shall be supplied as a single entity meeting all applicable UL555 and UL555S qualifications for both dampers and actuators. Manufacturer shall provide factory assembled sleeve of at least 17" long (contractor to verify maximum requirement). Factory supplied caulked sleeve shall be 20 gauge for dampers through 84" wide and 18 gauge for dampers above 84" wide. 12" or 22" single piece picture frame mounting angles shall be factory supplied and shipped on each damper/sleeve assembly. Factory shall supply sleeves to accommodate square, rectangular, round, or oval ducts.

E. Each combination fire/smoke damper shall be equipped with a controlled 7 to 15 second heat-actuated release device. The electric EFL shall close and lock the fire/smoke damper during test, smoke detection, power failure or fire conditions through actuator closure springs. To prevent duct and HVAC component damage, the damper shall at all times be connected to the actuator for controlled closure in not less than 7 seconds and no more than 15 seconds. Instantaneous damper closure is unacceptable. Damper shall be manually resettable after activation by heat and after exposure to high temperature or fire, the damper must be inspected prior to reset to ensure proper operation. Release temperatures are 165°F. 1-1/2 hour dampers shall be Ruskin model FSD60 or equivalent and 3 hour dampers shall be Ruskin model FSD60-3 or equivalent.

2.11 GRAVITY BACKDRAFT DAMPERS (LOW VELOCITY COUNTERBALANCE TYPE) (< 2.0” w.c.)

A. Acceptable Manufacturers: Air Balance, American Warming, Arrow United (Type 655), Louvers and Dampers Inc., Prefco, Ruskin (CBD4 or CBD6), C.E. Sparrow, Airstream, Greenheck, Pottorff.

B. Gravity backdraft dampers, size 18 x 18 inches or smaller, furnished with air moving equipment, may be air moving equipment manufacturers standard construction.

C. Fabricate multi-blade, parallel action gravity balanced backdraft dampers of 16 gauge galvanized steel or extruded aluminum, with center pivoted blades of maximum 6 inch width, with felt or flexible vinyl sealed edges, linked together in rattle-free manner with 90 degree stop, steel ball bearings, and plated steel pivot pin; adjustment device to permit setting for varying differential static pressure.

2.12 INSULATED FLEXIBLE ROUND DUCTWORK

A. Manufacturer: Flexmaster Type 5B - Insulated.

B. Other acceptable manufacturers offering equivalent product subject to compliance with specified requirements: Genflex, Thermaflex, Wiremold, Cleva-Flex, H.K. Porter Co., Cal-Flex, Hart & Cooley, Hercules, Quietflex.

C. Insulated low pressure flexible duct factory fabricated assembly consisting of a coated fiberglass fabric mechanically interlocked by a corrosion resistant metal spiral helix wrapped with nominal 1 inch thick fiberglass insulation sheathed in a vapor barrier jacket.

D. Composite assembly, including insulation and vapor barrier shall be UL Listed 181 for Class 1 Air Duct Material and comply with NFPA Standard 90A.

E. Accessories: Spin collar fittings with adjustable damper including positive locking regulator damper hardware.

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2.13 FLEXIBLE DUCT FAN CONNECTIONS

A. Fabricate in accordance with SMACNA HVAC Duct Construction Standards, and as indicated.

B. Indoor: UL listed fire-resistant neoprene coated woven glass fiber fabric to NFPA 90A, minimum density 30 oz. per sq. yd., minimum 4-inch wide, crimped into metal edging strip.

C. Outdoor: UL listed hypalon coated woven glass fabric to NFPA 90A, minimum density 24 oz. per sq. yd., minimum 4-inch wide, crimped into metal edging strip.

D. Leaded vinyl sheet, minimum 0.55 inch thick, 0.87 lbs, per sq. ft., 10 dB attenuation in 10 to 10,000 Hz range.

2.14 ACCESS DOOR HARDWARE

A. Manufacturer: Ventfabrics Ventlok Series

B. Other acceptable manufacturers offering equivalent product: Duro Dyne.

C. Latches, hinges and gasketing:

Doors less than 4 square feet - Series 100.
Doors 4 to 8 square feet - Series 200.
Larger doors and in medium pressure systems - Series 300.

2.15 DUCT ACCESS DOORS

A. Fabricate in accordance with SMACNA HVAC Duct Construction Standards as indicated.

B. Review locations prior to fabrication.

C. Fabricate rigid and close-fitting doors of galvanized steel with sealing gaskets and quick fastening locking devices. For insulated ductwork, install minimum one inch thick insulation with sheet metal cover.

D. Access doors smaller than 12 inches square may be secured with sash locks.

E. Provide two hinges and two sash locks for sizes up to 18 inches square, three hinges and two compression latches with outside and inside handles for sizes up to 24 x 48 inches. Provide an additional hinge for larger sizes.

F. Access doors with sheet metal screw fasteners are not acceptable.

PART 3 - EXECUTION

3.1 GENERAL SHEET METAL INSTALLATION

A. Duct sizes fall within the limiting dimensions indicated on the Drawings. Provide sheet metal duct systems, connections, dampers, duct turns, housings, hinged sheet metal doors and necessary removable access doors for the complete supply, return, and exhaust systems. Install accessories in accordance with manufacturer's instructions.

B. Seal low and medium pressure ductwork per IECC and SMACNA HVAC Duct Construction Standards to Seal Class A. This includes all joints, seams and wall penetrations.

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C. Wherever exposed ducts pass through walls, floors, or ceilings, a 2-inch flanged sheet-metal collar fitting close around ducts to be slipped along duct until flange is tight against finished surface covering edges of openings and presenting a neat appearance. Lock collar to duct.

D. Wherever ducts penetrate floors or fire walls, install safing insulation to maintain fire wall integrity.

E. Cut or drill temporary test holes in ducts as required. Cap with neat patches, neoprene plugs, threaded plugs, or threaded or twist-on metal caps. Permanent test holes shall be factory fabricated, airtight flanged fittings with screw cap. Provide extended neck fittings to clear insulation.

F. Provide openings in ductwork where required to accommodate thermometers and controllers.

G. During construction provide temporary closures of metal or taped polyethylene on open ductwork to prevent construction dust from entering ductwork system.

H. Where Bellmouth fittings are specifically called for on Drawings, provide standard Bellmouth fittings per SMACNA Standards.

I. On smoke management system ducts, conduct a leakage test, per Chapter 9 of the 2009 IBC, to 1.5 times the design pressure. Total leakage shall not exceed 5% of design flow.

J. Wherever dampers are concealed under insulation, provide marker ribbon for identification. Hang ribbon below adjacent ductwork to allow view from any angle.

K. Requirements for duct liner are located in Specification Section 230540 – Mechanical Sound and Vibration Control.

3.2 SEALING OF DUCTWORK

A. Seal all ductwork to Seal Class A per SMACNA HVAC Duct Construction Standards and as required by the International Energy Conservation Code. Additional sealing of these runouts will be required if audible air leaks are observed. Where joints are not accessible for proper sealing, cut hand holes in duct and seal the joints from the inside.

3.3 DUCT LEAKAGE TESTING

A. Conduct a complete duct leakage test of all medium pressure supply air mains and vertical risers as outlined in the most current edition of the SMACNA Air Duct Leakage Test Manual. Unless specifically noted otherwise on Drawings, testing for medium pressure ductwork is defined as Leakage Class 6 for rectangular ductwork and Leakage Class 3 for round or flat oval ductwork.

B. Total leakage of each duct system not to exceed recommendations in SMACNA Air Duct Leakage Test Manual per Leakage Classifications defined above. If leakage rate exceeds maximum allowed, reseal ductwork until measured system leakage rate is less than the maximum allowable leakage rate.

C. Test all medium pressure ductwork 2” wc positive pressure and extrapolate values out to 6” wc positive pressure. Provide all necessary blank-offs to perform test.

D. Perform a leakage test on all field erected air handler casings from the outdoor/return air dampers through to the point the medium pressure duct connects to the discharge opening at the end of the air handler. Leakage shall be limited to 1% of design flow. Test casing to 2” wc positive pressure and extrapolate values out to 6” wc positive pressure. Provide all necessary blank-offs.

3.4 MANUFACTURED DUCT JOINTS

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A. The installation of the manufactured duct joints shall be in accordance with the manufacturer's printed instruction and installation manuals. Apply multiple thicknesses of folded butyl gasket material at each corner of rectangular duct joints to assure air tightness.

3.5 KITCHEN HOOD EXHAUST DUCTWORK

A. Provide residue traps in kitchen hood exhaust ducts at base of vertical risers with provisions for cleanout.

B. Weld dishwasher exhaust ductwork watertight and slope back to dishwasher hood.

C. Provide cleanouts inside wall of horizontal grease ducts where shown on drawings and as follows: Minimum cleanout opening size 12”x12”; first cleanout shall be within 20 ft. of hood, all subsequent cleanouts 20 ft. on center. Provide cleanouts within 10 ft. of all elbows greater than 45 degrees.

D. Perform a grease duct leakage test by using a minimum 100w light passed through the entire length of ductwork to determine that all welds are liquid-tight.

E. Horizontal grease ducts shall be sloped continuously towards the grease hood at ¼” per foot for duct lengths 75 ft. or less. Duct lengths greater than 75 ft. shall be sloped continuously at 1” per foot over the entire horizontal length of duct.

3.6 DUCTWORK APPLICATION SCHEDULE

A.

AIR SYSTEM	MATERIAL
Low Pressure Supply (Heating Systems)	Galvanized Steel
Low Pressure Supply (System with cooling coils)	Galvanized Steel
Return and Relief	Galvanized Steel
General Exhaust	Galvanized Steel
Kitchen Hood Exhaust	Stainless Steel
Low Pressure Flex Duct	Insulated Flexible Round Duct
Dishwasher Exhaust	Aluminum
Shower and Locker Room Exhaust	Galvanized Steel, Aluminum
Outside Air Intake	Galvanized Steel
Combustion Air	Galvanized Steel

3.7 DAMPER OPERATOR HARDWARE

A. Install per manufacturer’s instructions and recommendations. Coordinate any ceiling control locations prior to installation.

B. Coordinate length of flexible shaft on site.

3.8 VOLUME CONTROL DAMPERS

A. Provide balancing dampers at points on low pressure supply, return, and exhaust systems where branches are taken from larger ducts as required for air balancing.

3.9 FIRE DAMPERS, SMOKE DAMPERS AND COMBINATION FIRE/SMOKE DAMPERS

A. Provide fire dampers, combination fire and smoke dampers or smoke dampers at locations indicated, where ducts and outlets pass through fire rated components. Install with required perimeter mounting angles, sleeves, breakaway duct connections, corrosion resistant springs, bearings, bushings and hinges per manufacturer's instructions.

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B. Demonstrate re-setting of fire/smoke dampers and/or smoke dampers to authorities having jurisdiction and Owner's representative.

3.10 GRAVITY BACKDRAFT DAMPERS (LOW PRESSURE SYSTEMS)

A. Provide backdraft dampers on exhaust fans or exhaust ducts nearest to outside of building and where indicated.

B. Provide counter-balanced gravity backdraft dampers in return air duct sections from CRAC units to ceiling plenums to prevent air bypass from raised floor to ceiling space when CRAC unit fan is “off”.

3.11 MOTORIZED BACKDRAFT DAMPERS

A. Provide motorized backdraft dampers where shown on drawings.

3.12 INSULATED FLEXIBLE ROUND DUCTWORK

A. Connect diffusers or troffer boots to low pressure ducts with 6 feet maximum length of flexible duct.

B. Install flexible ducts in a fully extended condition, free of sags and kinks, using only the minimum length required to make the connection. Bends shall be made with not less than one duct diameter centerline radius. Provide radiused supports as necessary.

C. Where horizontal flex duct sags more than ½ inch per foot, suspend flexible duct on 35-inch centers with a minimum one inch wide flat bending material.

D. Where "lift-out" ceilings occur, install with volume damper in flex duct at connection to main duct.

E. Make all connections to metal ducts, diffusers, and troffer boots with draw bands or metal clamps. Use only continuous lengths of flexible duct, no joints are allowed between two lengths of flexible ducts.

3.13 FLEXIBLE DUCT FAN CONNECTIONS

A. Provide flexible connections immediately adjacent to equipment in ducts associated with fans and motorized equipment.

B. At least 1-inch slack shall be allowed in these connections to insure that no vibration is transmitted from fan to duct work. The fabric shall either be folded in with the metal or attached with metal collar frames at each end to prevent air leakage.

3.14 DUCT ACCESS DOORS

A. Provide duct access doors for inspection, maintenance and cleaning at all automatic dampers, flow station, humidifiers, fire and smoke dampers and duct turning vanes and before and after all booster coils.

B. Provide maximum 8 x 8 inch size for hand access, 24 x 24 inch size for shoulder access and as indicated.

C. Provide observation windows to see all automatic modulating dampers and fire and smoke dampers.

END OF SECTION 23 33 00

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SECTION 23 34 00 – AIR HANDLING FANS

PART 1 - GENERAL

1.1 WORK INCLUDED

A. Cabinet Fans

B. Power Roof Ventilators

C. Exhaust Fans (Ceiling Type)

D. Propeller Type Ventilation Fan

1.2 RELATED WORK

A. The General Conditions, Supplementary Conditions and Division 1, General Requirements apply to this section and Contractor shall review and adhere to all requirements of these documents.

1. Section 230500 - Basic Mechanical Requirements.
2. Section 230529 - Basic Mechanical Materials and Methods.
3. Section 230540 - Mechanical Sound and Vibration Control.
4. Section 230548 - Mechanical Seismic Control.
5. Section 230593 - Testing, Adjusting and Balancing.

1.3 QUALITY ASSURANCE

A. Manufacturer's Qualifications: Firms regularly engaged in manufacture of specified fans with characteristics, sizes, and capacities required, whose specified fan has been in satisfactory use in similar service for not less than 3 years.

1.4 SUBMITTALS

A. Submit shop drawings and product data for the following items under provisions of the General Conditions of the Contract:

1. Shop Drawings: Submit assembly-type shop drawings showing unit dimensions, weight loadings, required clearances, construction details, and field connection details for each fan.
2. Product Data: Submit manufacturer's technical product data for all fans showing dimensions, weights, capacities, ratings, fan performance curves with operating point clearly indicated, motor electrical characteristics, gages and finishes of materials. Provide multiple-speed performance curves for fans with variable speed drives.

B. Submit printed Operating Instructions and Maintenance Data for the following items under provisions of Operating and Maintenance Data paragraph in Section 230500:

1. All fans.

1.5 DELIVERY, STORAGE AND HANDLING

A. Deliver fans with factory-installed shipping skids and lifting lugs; pack components in factory-fabricated protective containers.

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B. Handle fans carefully to avoid damage to components, enclosures, and finish. Do not install damaged components; replace and return damaged components to fan manufacturer.

C. Store fans in clean dry place and protect from weather and construction traffic.

D. Comply with Manufacturer's rigging and installation instructions for unloading fans and moving them to final location.

1.6 EXTRA STOCK

A. Provide one spare set of belts for each belt-driven fan.

PART 2 - PRODUCTS

2.1 CABINET FANS

A. Acceptable Manufacturers: Subject to compliance with requirements, provide cabinet fan of one of the following: Loren Cook, Greenheck, Twin City, Trane, New York Blower, ACME, Peerless, Barry, Penn, Soler and Palau.

B. Furnish and install cabinet fans of size and capacity shown on drawings.

C. Cabinet shall be constructed of steel with removable panels for access to all internal parts.

D. Fan shall be double width, double inlet multi-blade centrifugal type with V-belt drive and adjustable speed sheave.

E. Fans shall be statically and dynamically balanced and shall run on permanently lubricated bearings.

F. Motor shall be provided per requirements of "Motors" in Section 230529.

2.2 POWER ROOF VENTILATORS

A. Acceptable Manufacturers: Subject to compliance with requirements, provide Power Roof Ventilator of one of the following: ACME, Jenn-Air, Penn, Greenheck, Cook, Powerline, Carnes, Twin City Fans, Soler and Palau.

B. Furnish and install Power Roof Ventilators of model, size and capacity as shown on Drawings.

C. Housings shall be of contour, type, and material as shown on drawings.

D. Fan: Shall be the backwardly inclined type with centrifugal wheel that has been statically and dynamically balanced at the factory.

E. Motor: Shall be installed in a totally enclosed weatherproof housing outside of the air stream and in accordance with "Motors" in Section 230529.

F. Drive: Units shall be belt driven. Belt shall be oil resistant. An adjustable sheave on the motor shall be provided to allow changes in the fan speed.

G. Installation: Ventilators shall be installed on the roof on a nominal 12-inch high, pre-fabricated, self-flashing aluminum curb with 2" fiberglass insulation and metal liner, furnished with the fan.

H. Disconnect Switch: A factory wired non-fused disconnect switch shall be located under the hood of the unit.

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I. Backdraft Dampers: Shall be installed on the curb of the unit unless specifically shown otherwise on the Drawings.

J. Bird Screen: Entire air outlet of the fan shall be protected by a 1/2" x 1/2" aluminum mesh securely installed in place.

K. Kitchen Exhaust Fans: In addition to the above requirements, provide kitchen exhaust fans U.L. listed for grease removal. Provide drain connection and grease trap, external disconnect switch, and curb extension.

2.3 EXHAUST FANS (CEILING TYPE)

A. Acceptable Manufacturer: Subject to compliance with requirements, provide ceiling type exhaust fan of one of the following: Penn Co. (Zephyr Model), ILG, Pace, Cook, Jenn-Air, Greenheck, ACME, Carnes, Twin City Fan, Broan, Soler and Palau.

B. Type: Shall be of the centrifugal fan, integral grille and housing type, all completely self-contained.

C. Capacity: Capacity and model number of the units shall be as shown on drawings and shall be certified by AMCA.

D. Motor and Drive: Fan shall be of the direct drive type, and maximum fan motor speed shall be 1150 RPM. Motor shall be of the permanently lubricated ball bearing type and shall be directly coupled to the fan. The motor and fan shall be easily removable thru the intake grille for service. Direct drive fans to include solid state speed controllers.

E. Housing: Shall be constructed of heavy gauge steel and shall be completely insulated internally with acoustical insulation material to deaden sound.

F. Backdraft Damper: Each fan shall be equipped with a nonmetallic backdraft damper constructed of neoprene and shall be shatterproof under all conditions.

G. U.L. Label: Each fan shall be approved by the Underwriters' Laboratories, Inc. and shall carry the U.L. Label.

H. Intake Grille: Shall be constructed of steel frame and woven steel grille with a minimum free area of 85%. Intake grille shall have a white, factory baked enamel finish.

2.4 PROPELLER TYPE VENTILATION FAN

A. Acceptable Manufacturers: Subject to compliance with requirements, provide propeller type ventilation fan of one of the following: ACME, Aerovent, Cook, Penn, Greenheck, Powerline, Coo lair, Soler and Palau, Peerless, Twin City, Barry, Trane.

B. Type: Shall be of the belt driven type.

C. Fan Blades: Shall be constructed of cast aluminum. Fan blades shall be quiet in operation and shall be statically and dynamically balanced at the factory.

D. Motor: Shall be either sleeve or ball bearing types; 1750 RPM with adjustable sheaves in accordance with "Motors" in Section 230529.

E. Accessories: Belt guard, motorized backdraft damper, safety screen enclosure, and as indicated on Drawings.

F. Size and Capacity: As scheduled on Drawings.

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PART 3 – EXECUTION

3.1 INSTALLATION OF FANS

A. Install fans where indicated, in accordance with equipment manufacturer's installation instructions, and with recognized industry practices, to ensure that equipment complies with requirements and serves intended purposes.

B. Coordinate with other work, including ductwork, floor construction, and electrical work as necessary to interface installation of air handling equipment with other work.

C. Access: Provide access space around fans for service as indicated, but in no case less than that recommended by manufacturer.

D. Do not operate fans for any other purpose, temporary or permanent, until ductwork is clean, filters in place, bearings lubricated, and fan has been test run under observation.

E. Support: Install floor-mounted fans on 4" high reinforced concrete pad, 6" larger on each side than unit base in accordance with Section 230529.

F. Mounting: Mount fans on vibration isolators, in accordance with manufacturer's instructions and Section 230540.

G. Seismic Restraint: Provide seismic restraints in accordance with Section 230548.

H. Electrical Wiring: Install electrical devices furnished by manufacturer but not specified to be factory-mounted. Furnish copy of manufacturer's wiring diagram submittal to Electrical Installer.

1. Verify that electrical wiring installation is in accordance with manufacturer's submittal and installation requirements of Division 26 sections. Do not proceed with equipment start-up until wiring installation is acceptable to equipment installer with rotation in direction indicated and intended for proper performance. If there is no rotation arrow supplied by the manufacturer, install a correct rotation arrow.

I. Duct Connections: Refer to Division 23 Air Distribution sections. Provide ductwork, accessories, and flexible connections as indicated.

J. Dryer exhaust booster fan airflow must be adjusted to match the dryer fan capacity. Booster fan airflow rate cannot exceed the dryer fan capacity.

3.2 FIELD QUALITY CONTROL

A. Upon completion of installation of air handling equipment, and after motor has been energized with normal power source, test equipment to demonstrate compliance with requirements. Where possible, field correct malfunctioning equipment, then retest to demonstrate compliance. Replace equipment which cannot be satisfactorily corrected.

3.3 EXTRA BELTS

A. Deliver one spare set of belts for each belt-driven fan unit, obtain receipt from Owner that belts have been received.

END OF SECTION 23 34 00

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SECTION 23 36 00 - AIR TERMINAL UNITS

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. VAV Single Duct Terminal Units.

1.2 RELATED REQUIREMENTS

A. The General Conditions, Supplementary Conditions and Division 1, General Requirements apply to this Section, and Contractor shall review and adhere to all requirements of these documents.

B. Section 230500 - Basic Mechanical Requirements.

1.3 RELATED SECTIONS

A. Section 230529 - Basic Mechanical Materials and Methods.

B. Section 230900 - Electronic Controls.

C. Section 230593 – Testing, Adjusting, and Balancing

1.4 SUBMITTALS

A. Submit Product Data for the following items under provision of The General Conditions of the Contract:

1. VAV room terminals.
2. VAV boxes.
3. Computerized damper system.
4. Thermally powered VAV diffusers.
5. Submit product data indicating configuration, general assembly, and materials used in fabrication. Include catalog performance ratings which indicate air flow, static pressure, and NC designation.
6. Include schedules listing discharge and radiated sound power level for each of second through sixth octave bands at inlet static pressures of one to 4 inch wg.

B. Submit printed Operating Instructions and Maintenance Data for the following items under provisions of Operating and Maintenance Data paragraph in Section 230500.

1. VAV room terminals.
2. VAV boxes.

PART 2 - PRODUCTS

2.1 VAV LOW PRESSURE ZONE TERMINAL UNITS

A. Manufacturers: York, Titus Model ESV, Carnes, Krueger, Price, Metal Air, Carrier, Tuttle & Bailey, Anemostat.

B. Terminal units designated of sizes shown on Drawings or terminal unit schedule. Units shall have factory catalog performance ratings which conform to cfm, static pressure, discharge and radiated sound power and attenuation designated.

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C. Construction:

1. Cabinets constructed of zinc-coated steel. Casing fabricated to prevent air leakage of no more than 2% of rated air quantity at 1/2" pressure. Internal surfaces acoustically and thermally insulated with 1" glass fiber material surface treated to prevent erosion and having UL approval meeting NBFU and NFPA-90.
2. Air volume damper assemblies made from exactly dimensioned extruded anodized aluminum components. Damper blades shall have extruded ribs which key into grooved shaft for permanent fix of damper. All internal damper pivot points nylon fitted for noiseless operation requiring no lubrication. Damper assemblies constructed to prevent air leakage at 1" inlet static pressure.
3. Velocity Controller: Factory calibrated and field adjustable to minimum and maximum air volumes; shall maintain constant airflow dictated by thermostat within 5 percent of set point while compensating for inlet static-pressure variations up to 4-inch wg (1000 Pa); and shall have a multipoint velocity sensor at air inlet.

D. Performance Testing and Rating:

1. Performance of units shall be rated in accordance with Industry Standard 880-94.

E. Controls:

1. Controls shall be electronic type as specified in Section 230900. Electric and electronic control devices shall be contained in a NEMA-1 enclosure with access panel sealed from airflow and mounted on side of VAV box.
2. Terminal Unit Controller: Pressure-independent, variable-air-volume controller with electronic airflow transducer with multipoint velocity sensor at air inlet, factory calibrated to minimum and maximum air volumes.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install in accordance with manufacturer's instructions.

B. Provide ceiling access doors or locate above easily removable ceiling components.

C. Support units individually from structure. Do not support from adjacent ductwork.

D. Connect to ductwork in accordance with Section 233300. Allow minimum 2.5 times duct diameter of straight hard duct at terminal inlet.

3.2 ADJUSTING VAV TERMINAL UNITS

A. Reset volume with damper operator attached to assembly allowing flow range modulation from 100 percent of design flow to 0 percent full flow. Set units with heating coils for minimum flow rates per VAV box schedule.

END OF SECTION 23 36 00

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SECTION 23 37 13 - AIR INLETS AND OUTLETS

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Diffusers.

B. Registers.

C. Grilles.

D. Goosenecks.

1.2 RELATED REQUIREMENTS

A. The General Conditions, Supplementary Conditions and Division 1, General Requirements apply to this Section, and Contractor shall review and adhere to all requirements of these documents.

B. Section 230500- Basic Mechanical Requirements.

1.3 RELATED SECTIONS

A. Section 230529 - Basic Mechanical Materials and Methods: Painting of ductwork visible behind outlets and inlets.

B. Section 230593 - Testing, Adjusting and Balancing.

C. Section 233300 - Ductwork and Accessories.

D. Section 233600 - Air Terminal Units.

1.4 REFERENCES

A. AMCA 500 - Test Method for Louvers, Dampers and Shutters.

B. ANSI/NFPA 90A - Installation of Air Conditioning and Ventilating Systems.

C. ARI 890-91 - Rating of Air Diffusers.

D. ASHRAE 70 - Methods of Testing for Rating the Air Flow Performance of Outlets and Inlets.

E. SMACNA - HVAC Duct Construction Standard.

F. ASTM C 636 – Standard Practice for Installation of Metal Ceiling Suspension Systems for Acoustical Tile and Lay-In Panels.

1.5 QUALITY ASSURANCE

A. Test and rate performance of air outlets and inlets in accordance with ASHRAE 70 and ARI 890.

B. Test and rate performance of louvers in accordance with AMCA 500.

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1.6 REGULATORY REQUIREMENTS

A. Conform to ANSI/NFPA 90A.

1.7 SUBMITTALS

A. Submit Shop Drawings for the following items under provision of The General Conditions of the Contract:

1. Shop fabricated louvers.
2. Louvered penthouses.
3. Shop fabricated roof hoods.
4. Goosenecks.

B. Submit Product Data for the following items under provision of The General Conditions of the Contract:

1. Diffusers.
2. Registers.
3. Grilles.
4. Louvers.
5. Gravity roof hoods.

C. Submit schedule of outlets and inlets indicating type, size, location, application, and noise level.

1. Review requirements of outlets and inlets as to size, finish, and type of mounting prior to submitting product data and schedules of outlets and inlets.

PART 2 - PRODUCTS

2.1 CEILING DIFFUSERS (SEE AIR DEVICE SCHEDULE ON PLANS)

A. Acceptable Manufacturers: Titus, Anemostat, Barber Colman, Krueger, Carnes, Metal-Aire, Nailor-Hart, Tempo, Air Diffusion Products, Tuttle & Bailey, TurboX, Price, Hart & Cooley.

2.2 CEILING REGISTERS AND GRILLES (SEE AIR DEVICE SCHEDULE ON PLANS)

A. Acceptable Manufacturers: Titus, Anemostat, Barber Colman, Krueger, Carnes, Metal-Aire, Nailor-Hart, Tuttle & Bailey, Price, Hart & Cooley.

2.3 CEILING SLOT DIFFUSERS (SEE AIR DEVICE SCHEDULE ON PLANS)

A. Acceptable Manufacturers: Anemostat, Tempmaster, Tempo. (No Substitutions Allowed).

2.4 CEILING LINEAR EXHAUST AND RETURN GRILLES (SEE AIR DEVICE SCHEDULE ON PLANS)

A. Acceptable Manufacturers: Titus, Barber-Colman, Metal-Aire, Anemostat, Krueger, Tuttle & Bailey, Price.

2.5 WALL REGISTERS AND GRILLES (SEE AIR DEVICE SCHEDULE ON PLANS)

A. Acceptable Manufacturers: Titus, Metal-Aire, Barber-Colman, Anemostat, Krueger, Tuttle & Bailey, Air Concepts, Price.

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2.6 LINEAR WALL REGISTERS AND GRILLES (SEE AIR DEVICE SCHEDULE ON PLANS)

A. Acceptable Manufacturers: Titus, Barber-Colman, Metal-Aire, Anemostat, Krueger, Price, Tuttle & Bailey.

2.7 LINEAR SUPPLY REGISTERS AND GRILLES (SEE AIR DEVICE SCHEDULE ON PLANS)

A. Acceptable Manufacturers: Titus, Barber-Colman, Metal-Aire, Anemostat, Krueger, Price, Tuttle & Bailey.

2.8 LINEAR FLOOR REGISTERS AND GRILLES (SEE AIR DEVICE SCHEDULE ON PLANS)

A. Acceptable Manufacturers: Titus, Barber-Colman, Metal-Aire, Anemostat, Krueger, Price, Tuttle & Bailey.

2.9 LOUVERS

A. Acceptable Manufacturers: Dowco, Airstream, Louvers and Dampers, Inc., Ruskin, Krueger, Air Balance, American Warming and Ventilating, Arrow, C. E. Sparrow, Greenheck, Cesco, Pottorff, Air-Rite.

B. Provide 4 to 6 inch deep louvers with blades on 45 degree slope with center baffle and return bend, heavy channel frame, birdscreen with 1/2 inch square mesh for exhaust and 3/4 inch for intake.

C. Fabricate of 16 gauge galvanized steel or extruded aluminum, welded assembly, with factory finish, custom color to be selected by Architect.

D. Furnish with as per ceiling architectural ceiling description for installation.

2.10 GOOSENECKS

A. Fabricate in accordance with SMACNA HVAC Duct Construction Standards of minimum 18 gauge galvanized steel.

B. Mount on minimum 12 inch high curb base.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install items in accordance with manufacturers' instructions.

B. Install ceiling mounted items in accordance with ASTM C 636.

1. Ceiling mounted air terminals or services weighing less than 20 pounds shall be positively attached to the ceiling suspension main runners or to cross runners with the same carrying capacity as the main runners.
2. Terminals or services weighing 20 pounds but not more than 56 pounds, in addition to the above, shall have two No. 12 gauge hangers connected from the terminal or service to the ceiling system hangers or to the structure above. These wires may be slack.
3. Terminals or services weighing more than 56 pounds shall be supported directly from the structure above by approved hangers.

C. Check location of outlets and inlets and make necessary adjustments in position to conform with architectural features, symmetry, and lighting arrangement.

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D. Provide balancing dampers on duct take-off to diffusers, and grilles and registers, regardless of whether dampers are specified as part of the diffuser, or grille and register assembly.

E. Paint ductwork visible behind air outlets and inlets matte black.

F. Install diffusers to ductwork with air tight connection.

G. Install duct connections to fire rated UL Listed and Labeled diffusers and return grilles in strict accordance with instructions furnished by manufacturer.

END OF SECTION 23 37 13

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SECTION 23 57 00 - HEAT TRANSFER

PART 1 - GENERAL

1.1 RELATED WORK

A. The General Conditions, Supplementary Conditions and Division 1, General Requirements apply to this Section, and Contractor shall review and adhere to all requirements of these documents.

B. Related work specified in other Sections:

Section 230500 - Basic Mechanical Requirements
Section 230529 - Basic Mechanical Materials and Methods
Section 230540 - Mechanical Sound and Vibration Control
Section 230700 - Mechanical Insulation
Section 224476 - Swimming Pool Systems
Section 236400 - Refrigeration
Section 233400 - Air Handling Fans
Section 237400 - Air Handling Systems on Roof
Section 237410 – Air Handling Unit with Coils
Section 230900 - Electronic Controls
Section 230593 - Testing, Adjusting and Balancing

1.2 SYSTEM DESCRIPTION

A. The work includes, but is not limited to providing the following:

1. Electric Cabinet Heaters and Unit Heaters
2. Electric Baseboard Heaters

1.3 QUALITY ASSURANCE

A. Quality control shall be in accordance with Section 230500 - Basic Mechanical Requirements.

1.4 REFERENCES

A. Reference Standards: Except as modified by governing codes and by the Contract Documents, comply with the applicable provisions and recommendations of the following:

1. Comply with American National Standards Institute (ANSI B31.1) Code for Pressure Piping.

1.5 SUBMITTALS

A. Shop Drawings: Submit Shop Drawings and Product Data for the following items in accordance with the General Conditions of the Contract:

1. Electric Heating Equipment

B. Operating Instructions and Maintenance Data: Submit printed Operating Instructions and Maintenance Data for the following items in accordance with Operating and Maintenance Data paragraph in Section 230500:

1. Electric Heating Equipment

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PART 2 - PRODUCTS

2.1 ELECTRIC CABINET HEATERS AND UNIT HEATERS

A. Acceptable Manufacturers: Chromalox, Indeeco, Modine, Electromode, Sterling, Raywall, Markel, QMark.

B. Provide electric cabinet heaters and unit heaters of size and capacity as shown on Drawings.

C. Unit Cabinet: Shall be 14 gauge steel, enameled cabinet, color as selected by Architect, adjustable discharge louvers.

D. Motor and Blower Fans: Direct drive, blow-through design, two-speed motors and switch, resilient mounted. Motor and blower to be easily accessible for servicing. Bearings to be factory lubricated.

E. Electric Heating Elements: Fin-tube with helical fins with overheat protection. Unit to be furnished with thermostat for remote mounting as shown on drawings, tamperproof. Provide all contactors, relays, etc., as required. Entire unit to be U.L. approved.

F. Units to be provided with a summer-winter switch to allow operation without heat when desired. Operation as follows: Fan to be cycled by remote thermostat to maintain space temperature. Provide delay switch to keep fan from operating on call for heat until heating elements have warmed up.

2.2 ELECTRIC BASEBOARD HEATERS

A. Acceptable Manufacturers: Chromalox, Modine, Electromode, Thermador, Raywall, Markel, QMark.

B. Provide electric baseboard heaters of size and capacity as shown on Drawings.

C. Baseboard to be complete with all necessary heating elements, brackets, end enclosures, splice plates, etc., installed as recommended by the manufacturer. Front panel to be 18 gauge steel, U.L. approved.

D. Elements to be free from expansion noises and shall not produce hum. Provide all overheat protection and necessary contactors and relay integral with unit required for operation.

END OF SECTION 23 57 00

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SECTION 23 64 00 - REFRIGERATION

PART 1 - GENERAL

1.1 WORK INCLUDED

A. Cassette-Style Cooling Only Ductless Dx Fan Coil Split-Systems with Air-Cooled Condensing Units

B. Refrigerant Piping Materials and Products

C. Packaged Cooling Unit Ventilator

1.2 RELATED WORK

A. The General Conditions, Supplementary Conditions and Division 1, General Requirements apply to this section, and Contractor shall review and adhere to all requirements of these documents.

B. Related work specified in other Sections:

Section 230500 - Basic Mechanical Requirements
Section 230529 - Basic Mechanical Materials And Methods
Section 230540 - Mechanical Sound and Vibration Control
Section 230548 - Mechanical Seismic Control
Section 230593 - Testing, Adjusting and Balancing
Section 230700 - Mechanical Insulation
Section 232113 - HVAC Piping & Specialties
Section 232123 - HVAC Pumps
Section 232500 - HVAC Water Treatment
Section 238123 - Computer Room Air Conditioning

1.3 REFERENCES

A. Reference Standards: Except as modified by governing codes and by the Contract Documents, comply with the applicable provisions and recommendations of the following:

1. Air Conditioning and Refrigeration Institute (ARI):

   Standards for the following:

   # 210/240 - Unitary Air-Conditioning and Air-Source Heat Pump Equipment
   # 270 - Sound Rating of Outdoor Unitary Equipment
   # 410-72 - Plate Fin Type Refrigerant Coils

2. American National Standards Institute (ANSI):

   ANSI B9.1 "Safety Code for Mechanical Refrigeration." (Also known as ANSI/ASHRAE 15).

   ANSI B31.5 "Refrigeration Piping," and extend applicable lower pressure limits to pressures below 15 psig.

1.4 QUALITY ASSURANCE

A. Quality control shall be in accordance with Section 230500 - Basic Mechanical Requirements.

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B. The firm installing the refrigeration piping shall have at least 3 years of successful installation experience on projects with refrigeration piping system work similar to that required for this project.

C. Brazing Qualifications: Certify operators, brazing procedures and brazers in accordance with ANSI B31.5 for shop and job-site brazing of refrigerant piping work.

1.5 WARRANTY

A. All refrigerant compressors in this specification section shall be provided with a 10 year extended warranty for parts and labor in addition to the standard one year warranty required in Section 230500, for a total of 10 years of warranty coverage.

1.6 SUBMITTALS

A. Shop Drawings: Submit Shop Drawings and Product Data for the following items in accordance with the General Conditions of the Contract:

1. Compressors
2. Condensing Units
3. Cassette-Style Cooling Only Ductless Dx Fan Coil Split-Systems with Air-Cooled Condensing Units
4. Refrigerant Specialties
5. Packaged Cooling Unit Ventilator

B. Certificates: Before proceeding with refrigerant piping work, submit to the Architect/Engineer/Construction Manager/General Contractor two copies of Certification that brazing procedures, brazers and operators will be in accordance with ANSI B31.5.

C. Operating Instructions and Maintenance Data: Submit printed Operating Instructions and Maintenance Data for the following items in accordance with Operating and Maintenance Data paragraph in Section 230500.

1. Condensing Units
2. Cassette-Style Cooling Only Ductless Dx Fan Coil Split-Systems with Air-Cooled Condensing Units
3. Refrigerant Specialties
4. Packaged Cooling Unit Ventilator

PART 2 - PRODUCTS

2.1 AIR COOLED CONDENSING UNITS (5 TONS OR LESS)

A. Acceptable Manufacturers: LG, Carrier, Trane, York, McQuay, Sanyo, Mitsubishi, AAON.

B. Furnish and install factory assembled condensing units of the type, size and capacity shown on the equipment schedule on the Drawings. Unit performance shall be certified in accordance with latest edition of ARI Standards 210 and 270.

C. Units shall be of the packaged air cooled type as shown on the Drawings and consist of a reciprocating or rotary compressor, air cooled condenser and control panel completely factory wired and piped. Unit construction shall comply with ANSI B9.1 safety code, national electric code and ASME code.

D. The unit shall contain sufficient refrigerant <R-134a>, <R-407c> <or> <R-410> for complete system and be equipped with refrigerant line fittings which permit mechanical or sweat connection. Brass service valves with fittings and gage ports shall be located on exterior of unit.

E. Compressor shall be of the welded hermetic type with internal vibration isolation and be located in an isolated section of unit.

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F. Controls shall be factory wired and placed in a location readily accessible from top of unit. Compressor motor shall have both thermal and current sensitive overload devices.

G. Condenser coil shall be constructed with aluminum plate fins mechanically bonded to nonferrous tubing. Coil shall be protected by a grille. Condenser fan shall be propeller type, direct driven, and arranged for vertical air discharge. Fan motor shall be factory lubricated and internally protected.

H. Provide the following accessories:

1. Start capacitor and relay.
2. Indoor fan relay.
3. Liquid line filter drier.
4. Low ambient head pressure control.
5. Low voltage control transformer.
6. 7-Day Programmable thermostat with subbase.
7. Device to prevent damage to compressor caused by short cycling.
8. Crankcase heater.
9. 12” tall curb or snow stand.

2.2 AIR COOLED CONDENSING UNITS

A. Acceptable Manufacturers: LG, Carrier, Trane, York, McQuay, Sanyo.

B. Furnish and install factory assembled condensing units of the type, size and capacity shown on the equipment schedule on the Drawings. Unit performance shall be certified in accordance with latest edition of ARI Standards 210 and 270.

C. Units shall be of the packaged air cooled type as shown on the Drawings and consist of a reciprocating or rotary compressor, or multiples thereof, air cooled condenser and control panel completely factory wired and piped. Unit construction shall comply with ANSI B9.1 safety code, national electric code and ASME Code.

D. Refrigerant shall be R410A.

E. Each compressor shall be of the reciprocating serviceable hermetic type, and shall have an automatically reversible oil pump, operating oil charge, suction and discharge shutoff valves and shall be factory mounted on spring isolators.

F. Compressor motor shall be cooled by suction gas passing around the motor windings and shall be thermally protected.

G. Each compressor shall be equipped with an insert type crankcase heater of proper size to control oil dilution during shutdown.

H. Compressor shall unload in response to suction pressure for partial load operation. Compressor shall be located in a section separated from condenser fans and coil.

I. Multiple compressor units shall have step-start fans and coils. Compressor motor(s) shall have across-the-line start.

J. Condenser coil shall be nonferrous construction. Coil shall have aluminum plate fins, mechanically bonded to seamless copper tubes. Coil shall be circuited for subcooling.

K. Unit shall be furnished with direct-driven, propeller-type condenser fans arranged for vertical discharge. Condenser fan motors shall have inherent protection, and shall be of the permanently lubricated type, resiliently mounted. Each Fan shall have a safety guard. Controls shall be included for cycling fan(s) for intermediate season operation.

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L. Controls shall be factory wired and located in a separate enclosure. Safety devices shall consist of high and low pressure switches and compressor overload devices. Unit wiring shall incorporate a positive acting timer to prevent short cycling of compressor if power is interrupted. Timer shall prevent compressor from restarting for approximately 5 minutes after shutoff.

M. Each unit shall have a transformer to provide control circuit voltage.

N. Casing shall make unit fully weatherproof for outdoor installation. Casing shall be galvanneal steel, zinc phosphatized and finished with baked enamel.

O. Openings shall be provided for power and refrigerant connections. Panel shall be removable to provide access for servicing.

P. Only one power supply connection shall be required for each unit.

Q. Provide the following accessories:

1. Electric unloaders.
2. Pressure operated unloaders.
3. Remote control center and switch base for thermostatic control of unit from conditioned space.
4. Low ambient head pressure control.
5. Hot gas by-pass.

2.3 CASSETTE-STYLE COOLING-ONLY DUCTLESS DX FAN COIL SPLIT SYSTEMS WITH AIR COOLED CONDENSING UNITS

A. Acceptable Manufacturer: LG, Carrier, Trane, York, Mitsubishi.

B. Furnish and install factory assembled cooling-only split systems of the type, size and capacity shown on the equipment schedule on the Drawings. Unit performance shall be certified in accordance with latest edition of ARI Standards 210 and 270.

C. Condensing units shall be of the packaged air cooled type as shown on the Drawings and consist of a rotary compressor, air cooled condenser and control panel completely factory wired and piped. Unit construction shall comply with ANSI B9.1 safety code, national electric code and ASME code.

D. The condensing unit shall contain sufficient refrigerant (R134, R410A or R407) for complete system and be equipped with refrigerant line fittings which permit mechanical or sweat connection. Brass service valves with fittings and gage ports shall be located on exterior of unit.

E. Compressor shall be of the welded hermetic type with internal vibration isolation and be located in an isolated section of unit.

F. Controls shall be factory wired and placed in a location readily accessible from top of unit. Compressor motor shall have both thermal and current sensitive overload devices.

G. Condenser coil shall be constructed with aluminum plate fins mechanically bonded to nonferrous tubing. Coil shall be protected by a grille. Condenser fan shall be propeller type, direct driven, and arranged for vertical air discharge. Fan motor shall be factory lubricated and internally protected.

H. Unit to be housed in a fully weatherproof housing made of galvaneal steel, zinc phosphatized, with a baked enamel finish.

I. Condensing unit must be capable of serving DX fan coil located 22 vertical feet below the condenser.

J. Fan coil to be of size and capacity indicated on the drawings. Fan coil to mount on vertical wall surface and have a maximum height of 14”.

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K. Fan coil shall be complete with DX cooling coil, condensate pan and drain, direct drive fan, fan motor, filter, piping connectors, microprocessor control system, and integral thermostat. Include integral wall mounting bracket and mounting hardware.

L. Fan coil cabinet to be fully insulated for improved acoustical and thermal performance.

M. Fan coil to be configured with return air drawn in at top of front vertical face, and supply air discharged at bottom of front vertical face. Discharge to include manually adjustable horizontal and vertical deflection blades, as well as automatic motor driven vertical air sweep with on/off switch.

N. Fan coil unit to include a remote control that allows users to turn unit on/off, change setpoints, and change from fan-only to cooling mode.

O. Fan coil to connect to condensing unit for electrical power as necessary.

P. Provide the following accessories:

1. Start capacitor and relay.
2. Indoor fan relay.
3. Liquid line filter drier.
4. Low ambient kit (0°F).
5. Low voltage control transformer.
6. Device to prevent damage to compressor caused by short cycling.
7. Crankcase heater.
8. 14” high roof curb or 4” high concrete if slab on grade.
9. Factory installed starter and disconnect.

2.4 REFRIGERANT PIPING MATERIALS AND PRODUCTS

A. General:

1. Provide piping materials and factory-fabricated piping products of sizes, types, pressure ratings, temperature ratings, and capacities as indicated. Where not indicated, provide proper selection as determined by Installer to comply with installation requirements. Provide materials and products complying with ANSI B31.5 Code for Refrigeration Piping where applicable, base pressure rating on refrigeration piping system on maximum design pressures. Provide sizes and types matching piping and equipment connections; provide fittings of materials which match pipe materials used in refrigeration piping systems. Where more than 1 type of materials or products are indicated, selection is Installer's option.

B. Basic Pipe, Tube and Fittings:

1. Provide pipe, tube and fittings in accordance with the following:

Tube Size 4-1/8" and Smaller: Copper tube.
Wall Thickness: Type ACR, hard drawn temper.
Fittings: Wrought-copper, solder-joints, ANSI B16.22.
Joints: Brazed or soldered.

C. Refrigeration Valves:

1. Globe and Check Valves:

a. Acceptable Manufacturers: Subject to compliance with requirements, provide globe and check valves of one of the following:

Henry Valve Co.
Parker Hannifin Corp., Refrigeration & Air-Conditioning Div.
Sporlan Valve Co.

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b. Globe Shutoff Valves: Forged brass, packed, back seating, winged seal cap, 300 deg.F (149 deg.C) temperature rating, 500 psi working pressure.

c. Check Valves: Forged brass, accessible internal parts, soft synthetic seat, fully guided brass piston and stainless steel spring, 250 deg.F (121 deg.C) temperature rating, 500 psi working pressure.

2. Solenoid Valves:

a. Acceptable Manufacturers: Subject to compliance with requirements, provide solenoid valves of one of the following:

Alco Controls Div., Emerson Electric Co.
Automatic Switch Co.
Sporland Valve Co.

b. 2-Way Solenoid Valves: Forged brass, designed to conform to ARI 760, normally closed, Teflon valve seat, NEMA 1 solenoid enclosure, 115 volt, 60 Hz., UL-listed, 1/2" conduit adapter, 250 deg.F (121 deg.C) temperature rating, 400 psi working pressure.

D. Refrigeration Accessories:

1. Acceptable Manufacturers: Subject to compliance with requirements, provide refrigeration accessories of one of the following:

Alco Controls Div., Emerson Electric Co.
Henry Valve Co.
Parker-Hannifin Corp., Refrigeration & Air-Conditioning Div.
Sporlan Valve Co.
Toxalert

2. Refrigerant Strainers: Brass shell and end connections, brazed joints, Monel screen, 100 mesh, UL listed, 350 psi working pressure.
3. Moisture-Liquid Indicators: Forged brass, single port, removable cap, polished optical glass, solder connections, UL listed, 200 deg.F (93 deg.C) temperature rating, 500 psi working pressure.
4. Refrigerant Filter-Driers: Corrosion-resistant steel shell, steel flange ring and spring, wrought copper fittings, ductile iron cover plate with steel cap screws, replaceable filter-drier core, 500 psi working pressure.
5. Evaporator Pressure Regulators: Provide corrosion-resistant, spring loaded, stainless steel springs, pressure operated, evaporator pressure regulator, in size and working pressure indicated, with copper connections.
6. Refrigerant Discharge Line Mufflers: Provide discharge line mufflers as recommended by equipment manufacturer for use in service indicated, UL listed.

PART 3 - EXECUTION

3.1 REFRIGERATION EQUIPMENT INSTALLATION

A. General: Comply with manufacturer's recommended installation instructions.

B. Provide sound and vibration isolation in accordance with Section 230540 - Mechanical Sound and Vibration Control.

C. Equipment manufacturer to provide labor to assemble, test, charge, start-up, calibrate, and instruct Owner's personnel in operation and maintenance.

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3.2 REFRIGERATION SYSTEM INSTALLATION

A. Refrigerant Piping:

1. General: Install pipe, tube and fittings in accordance with recognized industry practices which will achieve permanently-leakproof piping systems, capable of performing indicated service without piping failure. Install each run with minimum joints and couplings, but with adequate and accessible unions for disassembly and maintenance/replacement of valves and equipment. Comply with ANSI B31 Code for Pressure Piping.
2. Piping to be kept clean and dry with factory installed caps in place until time of installation. Keep the entire system clean and dry during the installation. Piping to be straight and free of kinks, ripples, or restrictions of any kind. Bending the pipe will not be permitted. Fittings required to be of the long radius pattern except when used for oil traps.
3. Clean refrigerant piping by swabbing with dry lintless (linen) cloth, followed by refrigerant oil soaked swab. Remove excess oil by swabbing with cloth soaked in high flash point petroleum solvent, squeezed dry.
4. Pitch refrigerant piping 1" in 15 feet in direction of oil return to compressor. Provide oil traps and double risers where indicated, and where required to provide oil return.
5. Refrigeration system connections shall be of the sweat copper type properly cleaned and silver brazed with Sil-Fos or Easy-Flor solders using Handy and Harmon flux. Circulate nitrogen through tubes being soldered to eliminate the formation of copper oxide during the brazing operation.
6. Evacuation and leak test shall be made after refrigerant piping system is completed. The Contractor shall draw a vacuum on the entire system with a vacuum pump, the vacuum shall hold for 12 hours at 25 inches hg. of vacuum. The Contractor shall then break the vacuum with clean dry refrigerant, he shall then make a test with halide detector, after which he shall then draw another vacuum down to 25 in. and again break the vacuum with new clean dry refrigerant. The system shall then be fully charged with refrigerant and tested with halide detector at all joints.
7. Solder copper tube-and-fitting joints where indicated using silver-lead solder, ASTM B32, Grade 96 TS, in accordance with recognized industry practice. Cut tube ends squarely, ream to full inside diameter, and clean outside of tube ends and inside of fittings. Apply solder flux to joint areas of both tubes and fittings. Insert tube full depth into fitting, and solder in manner which will draw solder full depth and circumference of joint. Wipe excess solder from joint before it hardens.
8. Braze joints using American Welding Society (AWS) classification BCuP-4 for brazing filler metal. Bleed dry nitrogen through refrigerant piping during brazing operations.
9. Provide pipe hangers and supports in accordance with Section 230529 - Basic Mechanical Materials and Methods.

B. Refrigerant Valves:

1. Provide refrigerant type hand valves where indicated on the Drawings and wherever required for routine servicing. Install in accordance with manufacturer's instructions. Remove accessible internal parts before soldering or brazing, replace after joints are completed.
2. Solenoid Valves: Install in refrigerant piping as indicated with stem pointing upwards. Wire in accordance with "Electric Wiring" paragraph in Section 230529 - Basic Mechanical Materials and Methods.

C. Refrigerant Accessories:

1. Liquid indicators, strainers and filter-drier: Furnish and install in each refrigerant circuit and in accessible location for service.
2. Evaporator Pressure Regulators: Install in refrigerant suction lines or evaporator outlets as indicated. Adjust, if required, for proper evaporator pressure.
3. Refrigerant Discharge Line Mufflers: Install as indicated, in horizontal or downflow portion of hot-gas lines, immediately after leaving compressor; not in riser.

D. Refrigerant Coils:

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1. Mount refrigeration coils as shown on Drawings complete with drain pans and drain piping to floor drains.
2. Provide refrigeration piping with rubber sleeves to prevent vibration transmissions where piping passes thru plenum wall.

E. Equipment Connections:

1. General: Connect refrigerant piping to mechanical equipment in manner shown, and comply with equipment manufacturer's instructions where not otherwise indicated.
2. Provide flexible connections in suction and discharge lines at compressor and install valves where necessary for proper service and maintenance.
3. The oil level in the compressors to be checked or removed to achieve the correct level. The oil level to be rechecked after extended operation and adjusted accordingly.
4. Install refrigeration equipment on vibration isolation mountings in accordance with Section 230540 - Mechanical Sound and Vibration Control.

F. Dehydration and Charging System:

1. Install core in filter dryer after leak test but before evacuation.
2. Evacuate refrigerant system with vacuum pump, until temperature of 35 deg.F (2 deg.C) is indicated on vacuum dehydration indicator.
3. Provide manufacturer's recommended refrigerant charge to system to obtain optimum operating conditions.

END OF SECTION 23 64 00

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SECTION 23 65 00 – AIR-COOLED VARIABLE REFRIGERANT FLOW SYSTEMS

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes air-cooled variable refrigerant flow (VRF) heating and cooling systems.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product indicated.

B. Shop Drawings: Include plans, elevations, sections, details, and attachments to other work.

1. Detail equipment assemblies and indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
2. Factory approved shop drawings that detail the routing of all refrigeration piping, sizes and location of all refrigeration piping components.
3. Factory approved wiring diagrams for components and controls.
4. The mechanical contractor is responsible to update these plans during the course of the project with updated line lengths, unit serial numbers, addressing, pressure check verifications, and a record of weighed in refrigerant charge per system.

C. LEED Submittal:

1. Product Data for Credit EA Prerequisite 3 Fundamental Refrigeration management: Verify that the refrigerant used by the VRF does not contain CFC based refrigerants.
2. Product Data for Prerequisite EA 2 & Credit 1: Documentation indicating that units comply with applicable requirements in ASHRAE/IESNA 90.1.
3. Product Data for Prerequisite IEQ 1: Documentation indicating that units comply with ASHRAE 62.1, Section 5 - "Systems and Equipment."
4. Product Data for Credit IEQ 1: indicating compliance with the requirements of the credit.

1.3 CLOSEOUT SUBMITTALS

A. Operation and maintenance data.

1.4 QUALITY ASSURANCE

A. All bidders must submit reference for three (3) successfully completed VRF system installations.

B. All components of the VRF system shall be installed by staff who have completed the VRF system manufacturer’s installation and commissioning training. Submit certificates of training completion to the owner and engineer for review and approval prior to starting work.

C. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

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D. ASHRAE:

1. Fabricate and label refrigeration system to comply with ASHRAE 15, "Safety Standard for Refrigeration Systems".
2. ASHRAE Compliance: Applicable requirements in ASHRAE 62.1, Section 4 - "Outdoor Air Quality," Section 5 - "Systems and Equipment," Section 6 - " Procedures," and Section 7 - "Construction and System Start-up."

E. Engage a factory authorized representative to inspect the VRF system refrigeration system installation and submit a written report to the owner and engineer approving the installation prior to concealing any portion of the VRF refrigerant piping system within walls, above ceiling or in attics.

F. Engage a factory authorized representative to perform the initial VRF system start-up and written start-up report to the owner and engineer that approves the installation indicates that the system meets the manufacturer’s installation and commissioning requirements. Factory Authorized personnel shall be available within 24 hours for any service/warranty issues.

G. ASHRAE/IESNA Compliance: Applicable requirements in ASHRAE/IESNA 90.1.

1.5 WARRANTY

A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of split-system air-conditioning units that fail in materials or workmanship within specified warranty period.

B. Verify available warranties and warranty periods for units and components with manufacturers listed in Part 2 articles.

1. Warranty Period:

a. Compressor: 7 years from date of Substantial Completion.
b. Parts: 7 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Mitsubishi

B. LG

C. Daikin

D. Lennox.

2.2 VARIABLE REFRIGERANT FLOW AIR COOLED CONDENSING UNITS / HEAT PUMP UNITS WITH HEAT RECOVERY

A. General:

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1. See the mechanical equipment schedules for sizes and capacities
2. The condensing unit shall be factory assembled and pre-wired with all necessary electronic and refrigerant controls. The refrigeration circuit of the condensing unit shall consist of scroll compressors, motors, fans, condenser coil, electronic expansion valves, solenoid valves, distribution headers, capillaries, filters, shut off valves, oil separators, service ports and refrigerant regulator.
3. High/low pressure gas line, liquid and suction lines, and ball valves must be individually insulated, with min. ½" insulation between the condensing and indoor units.
4. The system will automatically restart operation after a power failure and will not cause any settings to be lost.
5. The following safety devices shall be included on the condensing unit: high pressure sensor and switch, low pressure sensor, control circuit fuses, crankcase heaters, fusible plug, overload relay, inverter overload protector, thermal protectors for compressor and fan motors, over current protection for the inverter and anti-recycling timers.
6. The condensing unit shall be capable of the scheduled capacities reflecting site elevation, design temperatures, line lengths, and defrost derations

B. Unit Cabinet:

1. The condensing unit shall be completely weatherproof and corrosion resistant. The unit shall be constructed from rust-proofed mild steel panels coated with a baked enamel finish.

C. Fan:

1. The condensing unit shall consist of one or more propeller type, direct-drive fan motors that have multiple speed operation via a DC (digitally commutating) inverter.
2. The condensing unit fan motor shall have multiple speed operation of the DC (digitally commutating) inverter type.
3. The fan motor shall have inherent protection and permanently lubricated bearings and be mounted.
4. The fan motor shall be provided with a fan guard to prevent contact with moving parts.

D. Condenser Coil:

1. The condenser coil shall be nonferrous construction with corrugated plate fins. The coil fins shall have a factory applied corrosion resistant finish. The coil shall be protected with an integral metal guard.

E. Compressor:

1. The inverter scroll compressors shall be hermetically sealed scroll type, variable speed controlled, capable of changing the speed to follow the variations in total cooling and heating load as determined by the suction gas pressure as measured in the condensing unit.
2. Each compressor shall be equipped with a crankcase heater, high pressure safety switch, and internal thermal overload protector.
3. Oil separators shall be standard with the equipment together with an intelligent oil management system.
4. The compressor shall be isolated to avoid the transmission of vibration.

F. Electrical:

1. See equipment schedule.

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2.3 VARIABLE REFRIGERANT FLOW AIR COOLED CONDENSING UNITS / HEAT PUMP UNITS

A. General:

1. See Schedule on drawings for size and capacity.
2. The outdoor unit shall be factory assembled and pre-wired with all necessary electronic and refrigerant controls. The refrigeration circuit of the condensing unit shall consist of a scroll compressor, motors, fans, condenser coil, electronic expansion valves, solenoid valves, distribution headers, capillaries, filters, shut off valves, oil separator, service ports and suction line accumulator.
3. Liquid and suction lines must be individually insulated, with min. 1/2” insulation, between the outdoor and indoor units.
4. The system will automatically restart operation after a power failure and will not cause any settings to be lost.
5. The following safety devices shall be included on the condensing unit: high pressure switch, low pressure sensor, control circuit fuses, crankcase heaters, fusible plug, overload relay, inverter overload protector, thermal protectors for compressor and fan motors, over current protection for the inverter and anti-recycling timers.
6. The system shall be capable of performing continuous operation when an individual indoor unit is being serviced or power to indoor unit is disconnected.

B. Unit Cabinet:

1. The outdoor unit shall be completely weatherproof and corrosion resistant. The unit shall be constructed from rust-proofed mild steel panels coated with a baked enamel finish.

C. Fan:

1. The condensing unit shall consist of propeller type, direct-drive fan motors that have multiple speed operation via a DC (digitally commutating) inverter.
2. The fan motor shall have inherent protection and permanently lubricated bearings.
3. The fan motor shall be provided with a fan guard to prevent contact with moving parts.

D. Condenser Coil:

1. The condenser coil shall be nonferrous construction with corrugated plate fins. The coil fins shall have a factory applied corrosion resistant finish. The coil shall be protected with an integral metal guard.

E. Compressor

1. The inverter scroll compressor shall be variable speed controlled hermetically sealed scroll type, capable of changing the speed to follow the variations in total cooling and heating load.

2. The inverter scroll compressors shall be variable speed controlled which is capable of changing the speed to follow the variations in total cooling and heating load as determined by the suction gas pressure as measured in the condensing unit.

3. Each compressor shall be equipped with a crankcase heater, high pressure safety switch, and internal thermal overload protector.

4. Oil separators shall be standard with the equipment together with an intelligent oil management system.

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5. The compressor shall be isolated to avoid the transmission of vibration.

2.4 ELECTRICAL

A. See schedule for electrical data.

B. Condensing units of 2 or more chassis shall have independent electrical circuits with disconnects provided by the electrical contractor.

2.5 INDOOR FAN COIL UNITS

A. The indoor fan coil units shall be completely factory assembled and tested. Included in the unit is factory wiring, piping, electronic expansion valve, control circuit board, fan motor thermal protector, flare connections, condensate drain pan, condensate drain pump, condensate safety shutoff and alarm, self-diagnostics, auto-restart function, fused time delay, and test run switch.

B. Indoor unit and refrigerant pipes will be charged with dehydrated air prior to shipment from the factory.

C. Both refrigerant lines shall be insulated from the outdoor unit.

D. The indoor units shall be equipped with a condensate pan with condensate pump, route to newest drain with air gap.

E. The indoor units shall be equipped with a return air temperature sensor.

F. Unit Cabinet:

1. The cabinet shall be constructed with sound absorbing foamed polystyrene and polyethylene insulation.

G. Fan:

1. The fan shall be direct-drive with three fan speeds available.
2. The fan motor shall be equipped as standard with adjustable external static pressure (ESP) settings.

H. Coil:

1. Coils shall be of the direct expansion type constructed from copper tubes expanded into aluminum fins to form a mechanical bond.
2. The coil shall be of a waffle louver fin and high heat exchange, rifled bore tube design to ensure highly efficient performance.
3. The coil shall be completely factory tested.
4. The refrigerant connections shall be flare connections and the condensate will be 1 -1/4 inch outside diameter PVC.
5. A condensate pan shall be located under the coil.

I. Electrical:

1. See schedule for electrical data.

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2.6 REFRIGERANT SELECTOR BOX

A. General: The refrigerant selector boxes are designed specifically for use with heat recovery system components.

1. The refrigerant selector boxes shall be factory assembled, wired, and piped.
2. The refrigerant selector box controllers must be run tested at the factory.
3. When simultaneously heating and cooling, the units in heating mode shall energize their sub-cooling electronic expansion valve.
4. Provide all incoming and outgoing connection ports with serviceable refrigerant ball valves for unit isolation.
5. Provided condensate drain and integral drain pan with safety shut off switch if required by manufacturer

B. Unit Cabinet:

1. Units shall have a galvanized steel plate casing.
2. Each cabinet shall house from 2 to 4 electronic expansion valves for refrigerant control.
3. The cabinet shall contain a sub-cooling heat exchanger.

C. Refrigerant Valves:

1. The unit shall be furnished with electronic solenoid valves or electronic expansion valves to control the direction of refrigerant flow.
2. The refrigerant connections must be of the brazed or flared type.

3. Electrical:

4. See schedule.

2.7 PRESSURE INDEPENDENT DAMPER

A. Approved Manufacturer:

1. United Enertech
2. American Aldes

B. Damper shall operate on duct pressure and require no external power supply.

C. Each damper shall be pre-set and factory calibrated, requiring no field adjustment to the airflows as indicated on the schedule, and shall be rated for use in air temperatures ranging from -25° to 140°F

D. Constant airflow regulators shall be capable of maintaining constant airflow within +/- 10% of scheduled flow rates (15% for units 50 CFM or less), within the operating range of 0.2 to 0.8 in. w.g. differential pressure.

E. Dampers must be classified per UL 2043 and carry the UL mark indicating compliance.

2.8 NETWORK CONTROLS & BMS GATEWAY

A. General:

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1. The VRF Controls Network shall be capable of supporting remote controllers, schedule timers, system controllers, centralized controllers, an integrated web based interface, graphical user workstation, and system integration to Building Management Systems via BACnet® and LonWorks®.
2. The Open Protocol Interface communication wiring shall be terminated in a daisy chain design at the outdoor unit, which is then daisy chained to refrigerant manifolds, then daisy chained to each indoor unit in the system and terminating at the farthest indoor unit. The remote control wiring shall run from the indoor unit control terminal block to the remote controller connected with that indoor unit.

B. VRF Controls Network:

1. The VRF Controls Network is made up of local remote controllers, multi-zone controllers, advanced multi-zone controllers, and open protocol network devices that transmit information via the communication bus. The VRF Controls Network shall also have the ability to be accessed via a networked PC. The VRF Controls Network supports operation monitoring, scheduling, error e-mail distribution, general user software, maintenance support, and integration with Building Management Systems (BMS) using open protocol via BACnet® or Lonworks® interfaces.

C. Open Protocol Interfaces:

1. The Open Protocol Interfaces are designed as a translator between the proprietary communications and the protocols used in BACnet and Lonworks integration. The Open Protocol Gateways wiring consist of a stranded two-wire connection to the outdoor unit. The Open Protocol Interfaces may be wall-mounted and can be used in conjunction with a Building Management System (BMS). In cases where a system or unit error may occur, the VRF controllers and the BMS central monitoring system will display an error.

D. Interface for use in BACnet:

1. The Interface for use in BACnet shall provide the ability for a Building Management System (BMS) to control all indoor fancoil units and outdoor condensing units.
2. The Interface for use in BACnet shall support centralized controller, local remote controller, system configuration, daily/weekly scheduling, monitoring of operation status, and malfunction monitoring.
3. The Interface for use in BACnet uses a standard open protocol based on ANSI/ASHRAE Standard 135. The BACnet Interface has been certified by the BACnet Testing Laboratories (BTL). The BACnet Interface is compatible with BACnet IP (ISO16484-5).
4. The interface wiring shall consist of a two-wire connection to the terminals of the outdoor unit. The Interface for use in BACnet is wall mounted and is used as a translator between the BACnet Building Management System (BMS) and the VRF communication bus to maintain the optimal operation of the connected indoor unit(s).
5. The Interface for use in BACnet shall be equipped with one ethernet port to support interconnection with a network PC via the Internet or Local Area Network (LAN).
6. The Interface for use in BACnet shall be capable of being configured as a foreign device. It shall be capable of communicating across BACnet Broadcast Management Devices (BBMD) in different subnet networks.
7. The Interface for use in BACnet shall be capable of supporting Change of Value (COV) notification for all available objects.

E. Mounting:

1. The Interface for use in BACnet shall be mounted on the wall or in an enclosure.

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F. Display Features:

1. The Interface for use in BACnet shall be capable of displaying indoor unit objects on the BACnet building management system.
2. The Interface for use in BACnet shall provide the BACnet building management system the capability to command the setpoint temperature in 1 deg F increments.
3. Display of temperature setpoint information shall be configurable for Fahrenheit or Celsius.
4. Display of room temperature information shall be configurable for Fahrenheit or Celsius.
5. Error codes generated by the indoor units, outdoor units, branch selector boxes, and remote controllers shall be displayed on the BACnet building management system in the event of system abnormality/error

G. Basic Operation:

1. The Building Management System shall control the following group operations:

   a. On/Off
   b. Operation Mode (Cool, Heat, Fan, Auto, and Dry)
   c. Setpoint setting for Cooling and Heating in the occupied mode.
   d. Fan status
   e. Fan Speed
   f. Up to 3 speeds (dependent upon indoor unit type)
   g. Vane direction (dependent upon indoor unit type)
   h. 5 fixed positions or swing position
   i. Remote controller permit/prohibit of On/Off, Mode, and Setpoint
   j. Filter sign reset for indoor units
   k. Disable the controller
   l. Forced off of indoor units
   m. Forced Thermo-off of indoor units
   n. Energy saving offset of indoor unit setpoint
   o. Compressor status
   p. Thermo-on status
   q. Heater status
   r. Capable of providing battery backup power for up to 3 years in total time for the clock.
   s. Settings stored in non-volatile memory.

H. Programmability:

1. The BACnet building management system shall support weekly schedule settings through its programming.

2. The schedule shall support the indoor unit:

   a. On/Off
   b. Each scheduled event shall specify time and target group
   c. Each scheduled event shall include On/Off, Operation Mode, Occupied Cooling Setpoint, Occupied Heating Setpoint, Setup (Cooling) setback setpoint, Setback (Heating) setback setpoint, Remote Controller On/Off Permit/Prohibit, Remote Controller Mode Permit/Prohibit, Remote Controller Setpoint Permit/Prohibit, and Timed Override Enable
   d. Setup (Cooling) and Setback (Heating) setpoints when unit is Off (unoccupied) by Group

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e. An override shall be provided for use enabling indoor unit operation during the unoccupied period by the BACnet building management system programming.

3. The BACnet building management system shall support auto-changeover through its programming.

a. Auto-change shall provide changeover for both Heat Pump and Heat Recovery systems based upon the group configurations. This will allow for the optimal room temperature to be maintained by automatically switching the indoor unit's mode between Cool and Heat in accordance with the room temperature and setpoint temperature.
b. Changeover to cooling mode shall occur when the room temperature is great than or equal to the cooling setpoint
c. Differential to be determined by BACnet building management system programming
d. Changeover to heating mode shall occur when room temperature is less than or equal to the heating setpoint.
e. Differential to be determined by BACnet building management system programming
f. Guard Timer:

1. Upon changeover, guard timer will prevent another changeover during this period.
2. Guard timer should be ignored by a change of setpoint manually from the BMS, Room Controller, Remote Controller, or by schedule.
3. Guard timer to be configured by BACnet building management system programming.

I. Thermostat / Room Controller:

1. General: Each indoor unit control circuit board shall supply the required DC voltage to the local remote controller. The voltage may rise or fall in relation to the transmission packets that are sent and received.
2. Wiring: The control wiring shall be terminated in a daisy chain design from outdoor unit, to refrigerant selector box, then daisy chaining to each indoor unit in the system and terminating at the farthest indoor unit. The remote control wiring shall run from the indoor unit control board terminal block to the remote controller connected with that indoor unit.
3. Local Remote Controllers:

a. All local remote controllers are to be compatible with all VRF indoor units. The remote controller wiring consist of a two-wire connection to the indoor unit. The local remote controllers may be wall-mounted and can be adjusted to maintain the optimal operation of the connected indoor unit(s). Set temperatures can be adjusted in increments of 1°F. In the cases where a system or unit error may occur, the VRV controllers will display an error code and the unit address
b. Wall Mounted Remote Controller:
c. The Wall Mounted Remote Controller can provide control for all VRF indoor units. The remote controller wiring consist of a two-wire connection to the indoor unit at terminals. The Remote Controller is wall mounted and can be adjusted to maintain the optimal operation of the connected indoor unit(s).
d. Mounting:

1. The Remote Controller shall be mounted into a standard 2" x 4" junction box.

e. Display Features:

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1. The controller shall display Operation Mode, Setpoint, and Fan Speed.

2. The controller shall display temperature setpoint in one degree increments.
3. Detailed display will reflect room temperature
4. Display of temperature information shall be configurable for Fahrenheit or Celsius
5. On/Off status shall be displayed with an LED.
6. Error codes will be displayed in the event of system abnormality/error.
7. A blinking LED will also signal system abnormality/error
8. The following system temperatures can be displayed to assist service personnel in troubleshooting:
9. Return Air Temperature
10. Liquid Line Temperature
11. Gas Line Temperature
12. Remote Controller Sensor Temperature
13. Temperature used for Indoor Unit Control

f. Basic Operation:

1. Capable of controlling a group of up to 16 indoor units.
2. Controller shall control the following group operations:
3. On/Off, Operation Mode (Cool, Heat, Fan, Dry and Auto* (*with VRF Heat Recovery System))
4. Independent Cooling and Heating setpoints in the occupied mode
5. Independent Cooling Setup and Heating Setback setpoints in the unoccupied mode
6. Fan Speed
7. Airflow direction (dependent on indoor unit type).
8. The controller shall be able to limit the user adjustable setpoint ranges individually for cooling and heating in the occupied period
9. Lock out key settings
10. Indoor unit group assignment

g. Programmability:

1. Controller shall support schedule settings with selectable weekly pattern options.
2. 7-day
3. Weekday + Weekend
4. Weekday + Saturday + Sunday
5. The schedule shall support unit On/Off
6. Independently settable Cooling and/or Heating setpoints when unit is on (occupied)
7. Setup (Cooling) and Setback (Heating) setpoints when unit is off (unoccupied)
8. A maximum of 5 operations can be schedulable per day
9. Time setting in 1-minute increments
10. The Controller shall support auto-changeover mode for both heat pump and heat recovery systems allowing the optimal room temperature to be maintained by automatically switching the indoor unit's mode between Cool and Heat according to the room temperature and temperature setpoint.
11. Changeover to cooling mode shall occur at cooling setpoint + 1 deg F
12. Changeover to heating mode shall occur at heating setpoint – 1 degF

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13. The Controller shall support an Auto Off Timer for temporarily enabling indoor unit operation during the unoccupied period.
14. When the Off Timer is enabled and when the unit is manually turned on at the remote controller
15. The room temperature shall be capable of being sensed at either the Remote Controller, the Indoor Unit return air temperature sensor (default), or Remote Temperature Sensor configured through the Remote Controller field settings.
16. Include dry contact for control of outside air dampers. Dampers to shut in unoccupied mode and open in occupied mode.

PART 3 – EXECUTION

3.1 INSTALLATION

A. VRF system manufacturer is required to furnish all VRF system factory control components for installation by the contractor.

B. Provide all labor and material required for the installation of the VRF control system.

C. Install all VRF system components per the manufacturer’s instructions and requirements.

D. Install all units level and plumb.

E. Install evaporator-fan components using manufacturer's standard mounting devices securely fastened to building structure.

F. Install ground-mounted, compressor-condenser components on 4-inch thick, reinforced concrete base that is 12 inches larger, on each side, than unit. Concrete, reinforcement, and formwork are specified in Section 03 3000 "Cast-in-Place Concrete." Coordinate anchor installation with concrete base.

G. If recommended by manufacturer, install compressor-condenser components on manufacturer-supplied stand, elevated to be 6” above anticipated snow depth,

H. Install seismic restraints.

I. Install and connect pre-charged refrigerant tubing to component's quick-connect fittings. Install tubing to allow access to unit.

3.2 CONNECTIONS

A. Where piping is installed adjacent to unit, allow space for service and maintenance of unit.

B. Duct Connections: Duct installation requirements are specified in Section 23 3113 "Metal Ducts." Drawings indicate the general arrangement of ducts. Connect supply and return ducts to split-system air-conditioning units with flexible duct connectors. Flexible duct connectors are specified in Section 23 3300 "Air Duct Accessories."

C. Install Pressure Independent airflow control dampers at outside air connection, sized for the required outside air flow rate required for each fan coil.

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3.3 FACTORY CONTROLS FIELD SETUP

A. Engage a factory-authorized service representative to perform the following tasks:

1. Address all units on the VRF system factory controls network and document addressing and settings for inclusion in the O&M Manuals. Share addressing information with the 230900 controls contractor as necessary.
2. Perform point-to-point confirmation/checkout of all addressed controls points on the VRF system factory controls network and verify proper controls system operation.
3. Assist the 230900 controls contractor with mapping points across the BACnet interface to the 230900 controls system.

3.4 FIELD QUALITY CONTROL

A. Perform tests and inspections:

1. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect components, assemblies, and equipment installations, including connections, and to assist in testing.

B. Tests and Inspections:

1. Leak Test: After installation, charge system and test for leaks. Repair leaks and retest until no leaks exist.
2. Operational Test: After electrical circuitry has been energized, start units to confirm proper motor rotation and unit operation.
3. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

C. Remove and replace malfunctioning units and retest as specified above.

D. Prepare test and inspection reports.

E. Factory authorized locally employed service personnel shall be available 24 hours per day/7 days per week for warranty service support during the warranty period.

3.5 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain units.

END OF SECTION 23 65 00

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Louisa May Alcott
Community School

SECTION 23 74 00 - AIR HANDLING SYSTEMS ON ROOF

PART 1 - GENERAL

1.1 RELATED WORK

A. The General Conditions, Supplementary Conditions and Division 1, General Requirements apply to this Section, and Contractor shall review and adhere to all requirements of these documents.

B. Related work specified in other Sections:

Section 230500 - Basic Mechanical Requirements
Section 230529 - Basic Mechanical Materials and Methods
Section 230540 - Mechanical Sound and Vibration Control
Section 230548 – Mechanical Seismic Control
Section 230593 - Testing, Adjusting and Balancing
Section 230700 - Mechanical Insulation
Section 230900 – Electronic Controls
Section 235400 - Fuel Fired Heaters
Section 236400 - Refrigeration

C. Work installed but furnished by others:

1. Damper motors for the rooftop evaporative cooling units.

1.2 SYSTEM DESCRIPTION

A. The work includes, but is not limited to providing the following:

1. Package Rooftop HVAC Units

1.3 QUALITY ASSURANCE

A. Quality control shall be in accordance with Section 230500 - Basic Requirements.

1.4 WARRANTY

A. All refrigerant compressors in this specification section shall be provided with a four-year extended warranty for parts and labor in addition to the standard one-year warranty required in Section 230500 for a total of 5 years of warranty coverage.

1.5 SUBMITTALS

A. Shop Drawings: Submit Shop Drawings and Product Data for the following items in accordance with the General Conditions of the Contract:

1. Packaged Rooftop HVAC Units

B. Operating Instructions and Maintenance Data: Submit printed Operating Instructions and Maintenance Data for the following items in accordance with Operating and Maintenance Data paragraph in Section 230500.

1. Packaged Rooftop HVAC Units

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1.6 EXTRA STOCK

A. Provide one complete extra set of filters for each air handling unit.

B. Provide one spare set of belts for each belt-driven air handling unit.

C. Provide one extra sump pump for evaporative media sumps.

PART 2 - PRODUCTS

2.1 GENERAL UNIT DESCRIPTION

A. 3-5 Ton = 17.5 SEER

B. 3-6 Ton High Eff = Direct Drive Multi Speed Motor

C. Unit(s) furnished and installed shall be packaged rooftop (s) as scheduled on contract documents and these specifications. Cooling capacity ratings shall be based on AHRI Standard Unit(s) shall consist of insulated weather-tight casing with compressor(s), air-cooled condenser coil, condenser fans, evaporator coil, return-air filters, supply motors and unit controls.

D. Unit(s) shall be 100% factory run tested and fully charged with R-454B

E. Unit(s) shall have labels, decals, and/or tags to aid in the service of the unit and indicate caution areas.

F. Units shall be convertible airflow design as manufactured.

G. Wiring internal to the unit shall be colored and numbered for identification.

2.2 UNIT CASING

A. Cabinet: Galvanized steel, phosphatized, and finished with an air-dry paint coating with removable access panels. Structural members shall be 18 gauge with access doors and removable panels of minimum 20 gauge.

B. Units cabinet surface shall be tested 1000 hours in salt spray test in compliance with ASTM B117.

C. Cabinet construction shall allow for all service/ maintenance from one side of the unit.

D. Cabinet top cover shall be one piece construction or where seams exits, it shall be double-hemmed and gasket-sealed.

E. Access Panels: Water- and air-tight panels with handles shall provide access to filters, heating section, return air fan section, supply air fan section, evaporator coil section, and unit control section.

F. Units base pan shall have a raised 1 1/8 inch high lip around the supply and return openings for water integrity.

G. Insulation: Provide 1/2 inch thick fiberglass insulation with foil face on all exterior panels in contact with the return and conditioned air stream. All edges must be captured so that there is no insulation exposed in the air stream.

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H. Provide openings either on side of unit or through the base for power, control, condensate, and gas connections.

I. The base of the unit shall have 3 sides for forklift provisions. The base of the units shall have rigging/lifting holes for crane maneuvering.

2.3 AIR FILTERS

A. Air Filters: Factory installed filters shall mount integral within the unit and shall be accessible through access panels. One-inch thick glass fiber disposable media filters shall be provided with the provisions within the unit for 2 inch thick filters to be field- provided and installed.

2.4 FANS AND MOTORS

A. Provide evaporator fan section with forward curved, double width, double inlet, centrifugal type fan.

B. Provide self-aligning, grease lubricated, ball or sleeve bearings with permanent lubrication fittings.

C. Provide units 5 tons and below with direct drive, multiple speed, dynamically balanced supply fans.

D. Outdoor and Indoor Fan shall be permanently lubricated and have internal thermal overload protection.

E. Outdoor fans shall be direct drive, statically and dynamically balanced, draw through in the vertical discharge position.

F. Provide shafts constructed of solid hot rolled steel, ground and polished, with key-way, and protectively coated with lubricating oil.

2.5 GAS FIRED HEATING SECTION

A. Completely assembled and factory installed heating system shall be integral to unit, UL or CSA approved specifically for outdoor applications for use downstream from refrigerant cooling coils. Threaded connection with plug or cap provided. Provide capability for gas piping

B. Heating section shall be factory run tested prior to shipment.

C. Induced draft combustion type with direct spark ignition system, redundant main gas valve, and 2-staged heat.

D. Gas Burner Safety Controls: Provide safety controls for the proving of combustion air prior to ignition, and continuous flame supervision. Provide flame rollout switches.

E. Induced draft blower shall have combustion air proving switches and built-in thermal overload protection on fan motor.

F. Heat Exchanger: Provide tubular section type constructed from 18-gauge aluminized steel.

G. Burners: Burners shall be of the in-shot type constructed of stainless steel.

H. Limit controls: High temperature limit controls will shut off gas flow in the event of excessive temperatures resulting from restricted indoor airflow or loss of indoor airflow.

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2.6 EVAPORATOR COIL

A. Provide configured aluminum fin surface mechanically bonded to copper tubing coil.

B. Provide an independent expansion device for each refrigeration circuit. Factory pressure tested at 450 psig and leak tested at 200 psig.

C. Provide a removable, reversible, cleanable double sloped drain pan for base of evaporator coil constructed of PVC.

2.7 CONDENSER SECTION

A. Provide vertical discharge, direct drive fans with aluminum blades. Fans shall be statically balanced. Motors shall be permanently lubricated, with integral thermal overload protection in a weather tight casing.

2.8 REFRIGERATION SYSTEM

A. Compressor(s): Provide scroll compressor with direct drive operating at 3600 rpm. Integral centrifugal oil pump. Provide suction gas cooled motor with winding temperature limits and compressor overloads.

B. Units shall have cooling capabilities down to 0 degree F as standard for field-installed low ambient accessory, the manufacturer shall provide a factory-authorized service technician that will assure proper installation and operation.

C. Provide each unit with refrigerant circuit(s) factory-supplied completely piped with liquid line filter-drier, suction and liquid line pressure ports.

2.9 EXHAUST/RETURN SECTION

A. Provide, on downflow units above 6 tons, a factory supplied field installed power exhaust assembly that shall assist the barometric relief damper in the economizer in relieving building pressurization.

2.10 OUTDOOR AIR SECTION

A. Provide economizer with powered exhaust.

B. Provide adjustable minimum position control located in the economizer section of the unit.

C. Provide spring return motor for outside air damper closure during unit shutdown or power interruption.

2.11 OPERATING CONTROLS

A. Thermostat: Provide a 24-volt programmable thermostat with 7 day night setback for each unit. Thermostat provides manual or automatic fan operation and system operation control of "heat", "cool", and fan "on", "auto" "off" positions. Thermostat shall control rooftop unit in full compliance with ASHRAE Standard 90.1.

B. Provide factory-installed indoor evaporator defrost control to prevent compressor slugging by interrupting compressor operation.

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C. Provide an anti-cycle timing and minimum on/off between stages timing in the microprocessor.

D. Economizer Preferred Cooling (if supplied with economizer) - Compressor operation is integrated with economizer cycle to allow mechanical cooling when economizer is not adequate to satisfy zone requirements. Compressors are enabled if space temperature is recovering to cooling setpoint at a rate of less than 0.2 degrees per minute. Compressor low ambient lockout overrides this function.

2.11 STAGING CONTROLS

A. Provide NEC Class II, electronic, adjustable zone control to maintain zone temperature setting

B. Provide programmable electronic microcomputer based zone control.

1. Zone control shall incorporate:

   a. Automatic changeover from heating to cooling.
   b. Set-up for at least 2 - sets of separate heating and cooling temperatures per day.
   c. Instant override of setpoint for continuous or timed period from one hour to 31 days.

2.
   a. Switch selection features including Fahrenheit display, 12 or 24-hour clock, keyboard disable, remote sensor, fan on-auto.
   b. Smart Fan Operation: Allows the unit fan operation to default to the Auto Mode during unoccupied periods, regardless of the Fan switch position.
   c. Economizer Minimum Position Override: Allows the unit controller to override and close the minimum position setting on the economizer damper during unoccupied time periods.

3. Zone sensor display shall be capable of:

   a. Time of day.
   b. Actual room temperature.
   c. Programmed temperature.
   d. Programmed time.
   e. Duration of timed override.
   f. Day of week.
   g. **System mode indication: heating, cooling, low battery, and fan on.**

C. Provide remote temperature sensor capability.

D. Provide mixed air sensor in supply air to close outside air damper.

2.12 STAGING CONTROLS

A. Provide NEC Class II, electronic, adjustable zone control to maintain zone temperature setting

B. Provide programmable electronic microcomputer based zone control.

1. Zone control shall incorporate:

   a. Automatic changeover from heating to cooling.
   b. Set-up for at least 2 - sets of separate heating and cooling temperatures per day.
   c. Instant override of setpoint for continuous or timed period from one hour to 31 days.
   d. Switch selection features including Fahrenheit display, 12 or 24-hour clock, keyboard disable, remote sensor, fan on-auto.

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e. Smart Fan Operation: Allows the unit fan operation to default to the Auto Mode during unoccupied periods, regardless of the Fan switch position.
f. Economizer Minimum Position Override: Allows the unit controller to override and close the minimum position setting on the economizer damper during unoccupied time periods.

2. Zone sensor display shall be capable of:

a. Time of day.
b. Actual room temperature.
c. Programmed temperature.
d. Programmed time.
e. Duration of timed override.
f. Day of week.
g. System mode indication: heating, cooling, low battery, and fan on.

C. Provide remote temperature sensor capability.

D. Provide mixed air sensor in supply air to close outside air damper.

2.14 ROOF CURB

A. Contractor shall provide factory supplied roof curb, 16 gauge perimeter made of zinc coated steel with supply and return air gasketing and wood nailer strips. Ship knocked down and provided with instructions for easy assembly.

B. Curb shall be manufactured in accordance with the National Roofing Contractors Association guidelines.

2.15 Acceptable Manufacturers: Trane, Carrier, York

PART 3 SEQUENCE OF OPERATIONS

3.1 PACKAGED ROOFTOP UNITS (RTU)

A. Microprocessor controller - Each RTU shall be controlled by a stand-alone microprocessor based controller with resident control logic. The controller will interface with the wall thermostats and the inputs and outputs in the points list to accomplish the following temperature control and energy conservation strategies.

1. Occupied Mode - All unit functions will be enabled for normal heating and cooling operation. Unit defaults to default temperature setpoints in the unit microprocessor.
2. Occupied Space Temperature Control - When in occupied mode as described above, the dedicated unit control shall operate stages of heating and cooling to maintain space temperature setpoint. Setpoints may be set by one of the following methods:

a. Locally through the thermostat by the occupant;
b. Operator may designate wild card setpoints to apply to any or all of the RTU's.

B. Optimal Start Mode - When the unit is turned on by the scheduling within the unit for optimal start, heating or cooling is provided as required. The outside air dampers, if provided, remains closed, in heating mode or mechanical cooling mode, until occupied time. Economizer cycle, if supplied, will be available if required.

C. Coastdown Mode - When the unit is turned "OFF" by the roof top unit for optimal stop, the supply

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fan remains "ON/AUTO", the outside air damper remains in minimum position for ventilation, and utilizes the unoccupied setpoints.

D. Demand Limit Mode - Demand Limit Mode shall be available. User defines maximum off time and temperature to ensure occupant comfort.

E. Night Setback Temperature Control - When the is in unoccupied mode, the unit shall be controlled to maintain user defined unoccupied heating and cooling setpoints. Adjustable start and stop temperature differentials will prevent short cycling. The outdoor air damper remains closed during heating night setback operation, if provided.

F. Economizer - Each RTU when equipped will measure and select lowest total heat air stream to meet cooling demands. When using return air, the outside air damper will be position at a minimum position. The minimum position will be adjustable by the operator.

G. Nighttime Free-Cool Purge Mode - An "economizer only" cooling cycle shall be provided during unoccupied hours when outdoor air conditions are suitable and the zone requires cooling.

H. Low Ambient Compressor Lockout - Compressor operation shall be disabled below a user defined outdoor air temperature.

I. Timed Override - When a timed override is initiated by the user, the unit will return to its user defined normal occupied mode for the user determined period of time.

J. Fire Shutdown - The unit will shut down in response to a customer supplied contact closure to the unit indicating the presence of a fire or other emergency condition.

K. Heat Pump Auxiliary Heat Lockout - Heat pump auxiliary heat operation shall be prevented above a user defined outdoor air temperature.

L. Unit status report - For each RTU unit, the unit shall provide an operating status summary of all sensed values (zone temperature, discharge temperature, etc.) setpoints and modes.

M. Supply Air Tempering - When the unit is in the heat mode, but not actively heating, if the supply air temperature drops 10 degrees or more below the heating setpoint, heat is turned on until supply air temperature rises to a point 10 degrees above the heating setpoint.

N. Alternating Lead/Lag - (Dual Compressors Models Only), During periods of part load operation, each compressor cycles alternatively as circuit number one in order to equalize wear and run time.

O. Economizer Preferred Cooling - Compressor operation is integrated with economizer cycle to allow mechanical cooling when economizer is not adequate to satisfy zone requirements. Compressors are enabled if space temperature is recovering to cooling setpoint at a rate of less than 0.2 degrees pe rminute. Compressor low ambient lockout overrides this function.

P. Diagnostic/Protection - The roof top unit system shall be able to alarm from all sensed points from the rooftop units and diagnostic alarms sensed by the unit controller. Alarm limits shall be designated for all sensed points.

R. The following options shall be provided on units:

1. Fused unit disconnect switch
2. 2 steps of compressor unloading
3. Hot gas bypasss
4. Low leak outside air dampers (max. 10 cfm/sf @ 4" s.p.)
5. High efficiency motors (90% +)

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6. Extended grease lines
7. Hinged access doors with cam lock handles
8. 115 volt/1 ph convenience outlet
9. Four (4) year extended warranty in addition to one (1) year standard warranty, for a total of five (5) years of warranty.
10. Two-stage gas valve
11. 100% modulating exhaust/return fans
12. Factory mounted smoke detector wired and mounted (5 ton and larger)
13. Coil guards
14. Brown out protection

PART 4 - EXECUTION

4.1 INSTALLATION OF AIR HANDLING EQUIPMENT

A. Install air handling equipment where indicated, in accordance with equipment manufacturer's installation instructions, and with recognized industry practices, to ensure that equipment complies with requirements and serves intended purposes.

B. Coordinate with other work, including ductwork, roof structure, floor construction, and electrical work as necessary to interface installation of air handling equipment with other work.

C. Do not operate fans for any purpose, temporary or permanent, until ductwork is clean, filters in place, bearings lubricated, and fan has been test run under observation.

D. Install units on vibration isolators or isolation bases, in accordance with Section 230540 - mechanical Sound and Vibration Control.

E. Contractor shall install in accordance with manufacturer's instructions.

F. Mount units on factory built roof mounting frame providing watertight enclosure to protect ductwork and utility services. Install roof mounting curb level.

4.2 EXAMINATION

A. Contractor shall verify that roof is ready to receive work and opening dimensions are as required.

B. Contractor shall verify that proper power supply is available.

4.3 ELECTRICAL CONNECTIONS

A. Ensure air handling equipment is wired properly, with rotation in direction indicated and intended for proper performance. If there is no rotation arrow supplied by the manufacturer, install a correct rotation arrow.

4.4 PACKAGED ROOFTOP HVAC UNITS

A. Install units on full perimeter support roof curbs where indicated per manufacturer's recommendations. Position units on roof structure as required to avoid ductwork or piping conflicts with roof structure.

4.5 INSTALLATION

A. Contractor shall install in accordance with manufacturer's instructions.

B. Mount units on factory built roof mounting frame providing watertight enclosure to protect ductwork and utility services. Install roof mounting curb level.

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4.6 FIELD QUALITY CONTROL

A. Upon completion of installation of air handling equipment, and after motor has been energized with normal power source, test equipment to demonstrate compliance with manufacturer start-up requirements. Where possible, field correct malfunctioning equipment, then retest to demonstrate compliance. Replace equipment which cannot be satisfactorily corrected.

4.7 FILTERS AND BELTS

A. Install extra set of new filters at completion of air handling system work, and prior to testing, adjusting and balancing work. Obtain receipt from Owner that new filters have been installed.

B. Deliver one spare set of belts for each belt-driven air handling unit, obtain receipt from Owner that belts have been received.

C. Deliver one spare sump pump per unit. Obtain receipt from Owner.

END OF SECTION 23 74 00

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SECTION 26 00 01 – 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. American Disability Act (ADA)
7. National Electrical Safety Code (NESC)
8. 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. When conflicts occur among codes, standards, drawings, and/or specifications, the most stringent requirements shall govern.

F. 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.

G. Provide only first-class workmanship from competent workers, conforming to the best electrical

construction practices.

H. The contractor shall have a current state contracting license applicable to type of work to be performed under this contract.

1.7 SUBMITTALS:

A. After the Contract is awarded but prior to ordering, manufacturing, or installation of any equipment, prepare complete Submittals including shop drawings, product data, cut sheets, etc. for materials and equipment as required by each section of the specifications.

B. 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.

C. Submit only materials and equipment specified in Construction Documents or Addendums.

D. 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.

E. 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.

F. 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 a complete and comprehensive submittal package including all specification sections at the same time. Exceptions may be given, with prior approval, for time-sensitive equipment.
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.

G. 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.

H. 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.

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 form 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.

C. Label for motor starters and/or thermal overload switches shall include heater size and F.L.A.

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. Switchgear
3. Generators
4. Similar Equipment

B. Extend bases 6" beyond equipment or mounting rails on all sides or as shown on the drawings. Not withstanding 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 265200 – Exterior Area Lighting.

D. Transformer Pads: Provide and locate properly sized concrete pads 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.

A. 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.

B. 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 26 00 01

SECTION 26 00 70 – ELECTRICAL CONNECTIONS FOR EQUIPMENT

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. This section is a Division 26 General Provisions section, and is part of each Division 26, 27, and 28 sections making reference to electrical connections.

1.2 DESCRIPTION OF WORK:

A. Extent of electrical connections for equipment include all final electrical connections for all equipment having electrical requirements including, but not necessarily limited to the following:

1. Equipment specified under all divisions of the contract. Refer to other divisions for specific electrical requirements.
2. Owner-furnished equipment
3. Kitchen Equipment

1.3 QUALITY ASSURANCE:

A. STANDARDS: Refer to Section 260001 – Electrical General Provisions as applicable.

B. SHOP DRAWINGS: Not required.

PART 2 – PRODUCTS

2.1 GENERAL:

A. Provide all materials for electrical connections including, but not necessarily limited to the following:

1. Raceways
2. Fittings
3. Conductors
4. Cords
5. Cord caps
6. Wiring devices
7. Pressure connectors
8. Lugs (CU-AL)
9. Electrical insulating tape
10. Heat-shrinkable tubing
11. Cable ties
12. Wire nuts
13. Other items and accessories as required.

B. Crimp on or slip-on type splicing materials designed to be used without wire stripping are not

acceptable.

C. Power Distribution Blocks: Provide Square D Type LB or Equivalent.

D. Refer to other Division 26, 27, and 28 Sections for specification of electrical materials as applicable.

PART 3 – EXECUTION

3.1 GENERAL:

A. Make electrical connections 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.

3.2 CONNECTIONS:

A. Permanently Installed Fixed Equipment:

1. Install conductors in flexible conduit from junction box to equipment control panel or connection point.
2. Where such installations are subject to moisture, install in liquid-tight flexible conduit.

B. Movable equipment:

1. Provide wiring devices, cord caps, and multi-conductor cables as required.

C. Other methods as required by the NEC and/or as required by special equipment or field conditions.

D. Power Distribution Blocks: Unless noted otherwise on drawings, provide power distribution blocks only for tapping of feeders and branch circuits. Locate in junction box or gutter in NEMA ratings to suit application.

3.3 MANUFACTURER'S INSTRUCTIONS:

A. Obtain manufacturer's instruction and wiring diagram regarding electrical connections of each piece of equipment and provide connections in accordance therewith.

3.4 VERIFICATION OF LOAD CHARACTERISTICS:

A. Verify electrical load characteristics of all equipment prior to rough-in. Review respective shop drawings of all other Divisions and Owner's equipment manuals. Report any variances from electrical characteristics noted in the contract documents to the Architect/Engineer prior to rough-in.

B. Value of rough-in work, electrical equipment, etc. installed and/or purchased by the contractor not meeting equipment requirements shall be credited back to the owner.

END OF SECTION 26 00 70

SECTION 26 00 72 – ELECTRICAL SUPPORTS AND SEISMIC RESTRAINTS

PART 1 – GENERAL

1.1 RELATED DOCUMENTS:

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

1.2 SUMMARY:

A. This Section includes the following:

1. Hangers and supports for electrical equipment and systems.
2. Seismic restraints for electrical equipment and systems.
3. Construction requirements for concrete bases.

1.3 DEFINITIONS:

A. IBC: International Building Code.

B. Seismic Restraint: A structural support element such as a metal framing member, a cable, an anchor bolt or stud, a fastening device, or an assembly of these items used to transmit seismic forces from an item of equipment or system to building structure and to limit movement of item during a seismic event.

1.4 SUBMITTALS:

A. Product Data: Illustrate and indicate style, material, strength, fastening provision, and finish for each type and size of electrical support and seismic-restraint component used.

1. Tabulate types and sizes of seismic restraints, complete with report numbers and rated strength in tension and shear as evaluated by an agency acceptable to authorities having jurisdiction.
2. Annotate to indicate application of each product submitted and compliance with requirements.

B. Shop Drawings: Indicate materials and dimensions and identify hardware, including attachment and anchorage devices, signed and sealed by a qualified professional engineer. Include the following:

1. Fabricated Supports: Representations of field-fabricated supports not detailed on Drawings.
2. Seismic Restraints: Detail anchorage and bracing not defined by details or charts on Drawings. Include the following:
   a. Design Analysis: To support selection and arrangement of seismic restraints. Include calculations of combined tensile and shear loads.
   b. Details: Detail fabrication and arrangement. Detail attachments of restraints to the restrained items and to the structure. Show attachment locations, methods, and spacings. Identify components, list their strengths, and indicate directions and values of forces transmitted to the structure during seismic events.
   c. Preapproval and Evaluation Documentation: By an agency acceptable to

authorities having jurisdiction, showing maximum ratings of restraint items and the basis for approval (tests or calculations).

C. Coordination Drawings: Show coordination of seismic bracing for electrical components with other systems and equipment in the vicinity, including other supports and seismic restraints.

D. Welding certificates.

E. Qualification Data: For professional engineer and testing agency.

F. Field quality-control test reports.

1.5 QUALITY ASSURANCE:

A. Comply with seismic-restraint requirements in the IBC unless requirements in this Section are more stringent.

B. Testing of Seismic Anchorage Devices: Comply with testing requirements in Part 3.

C. Welding: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."

PART 2 – PRODUCTS

2.1 MANUFACTURERS:

A. In other Part 2 articles where titles below introduce lists, the following requirements apply to product selection:

1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, manufacturers specified.

2.2 SUPPORT, ANCHORAGE, AND ATTACHMENT COMPONENTS:

A. Rated Strength: Adequate in tension, shear, and pullout force to resist maximum loads calculated or imposed under this Project, with a minimum structural safety factor of five times the applied force.

B. Steel Slotted Support Systems: Comply with MFMA-3, factory-fabricated components for field assembly.

1. Available Manufacturers:
   a. Cooper B-Line; a division of Cooper Industries.
   b. ERICO International Corporation.
   c. Allied Support Systems; Power-Strut Unit.
   d. GS Metals Corp.
   e. Michigan Hanger Co., Inc.; O-Strut Div.
   f. National Pipe Hanger Corp.
   g. Thomas & Betts Corporation.
   h. Unistrut; Tyco International, Ltd.
   i. Wesanco, Inc.
2. Finishes:

a. Metallic Coatings: Hot-dip galvanized after fabrication and applied according to MFMA-3.

3. Channel Dimensions: Selected for structural loading and applicable seismic forces.

C. Raceway and Cable Supports: As described in NECA 1.

D. Conduit and Cable Support Devices: Steel hangers, clamps, and associated fittings, designed for types and sizes of raceway or cable to be supported.

E. Support for Conductors in Vertical Conduit: Factory-fabricated assembly consisting of threaded body and insulating wedging plug or plugs for non-armored electrical conductors or cables in riser conduits. Plugs shall have number, size, and shape of conductor gripping pieces as required to suit individual conductors or cables supported. Body shall be malleable iron.

F. Structural Steel for Fabricated Supports and Restraints: ASTM A 36/A 36M, steel plates, shapes, and bars; black and galvanized.

G. Mounting, Anchoring, and Attachment Components: Items for fastening electrical items or their supports to building surfaces include the following:

1. Verify suitability of fasteners in subparagraph below for use in lightweight concrete or concrete slabs less than 4 inches (100 mm) thick.
2. 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. Available Manufacturers:
      1) Hilti, Inc.
      2) ITW Construction Products.
      3) MKT Fastening, LLC.
      4) Simpson Strong-Tie Co. Inc.
3. In the following subparagraph, use stainless steel anchors in corrosive environments.
4. Mechanical-Expansion Anchors: Insert-wedge-type, zinc-coated steel, for use in hardened portland cement concrete with tension, shear, and pullout capacities appropriate for supported loads and building materials in which used.
   a. Available Manufacturers:
      1) Cooper B-Line; a division of Cooper Industries.
      2) Empire Tool and Manufacturing Co., Inc
      3) Hilti, Inc.
      4) ITW Construction Products.
      5) MKT Fastening, LLC.
      6) Powers Fasteners.
5. Clamps for Attachment to Steel Structural Elements: MSS SP-58, type suitable for attached structural element.
6. Through Bolts: Structural type, hex head, high strength. Comply with ASTM A 325.
7. Toggle Bolts: All-steel springhead type.
8. Hanger Rods: Threaded steel.

2.3 SEISMIC-RESTRAINT COMPONENTS:

A. Rated Strength, Features, and Application Requirements for Restraint Components: As defined in reports by an agency acceptable to authorities having jurisdiction.

1. Structural Safety Factor: Strength in tension, shear, and pullout force of components used shall be at least five times the maximum seismic forces to which they will be subjected.

B. Angle and Channel-Type Brace Assemblies: Steel angles or steel slotted-support-system components; with accessories for attachment to braced component at one end and to building structure at the other end.

C. Cable Restraints: ASTM A 603, zinc-coated, steel wire rope attached to steel or stainless-steel thimbles, brackets, swivels, and bolts designed for restraining cable service.

1. Available Manufacturers:
   a. Amber/Booth Company, Inc.
   b. Loos & Co., Inc.
   c. Mason Industries, Inc.
2. Seismic Mountings, Anchors, and Attachments: Devices as specified in Part 2 "Support, Anchorage, and Attachment Components" Article, selected to resist seismic forces.
3. Hanger Rod Stiffener: Steel tube or steel slotted-support-system sleeve with internally bolted connections to hanger rod, of design recognized by an agency acceptable to authorities having jurisdiction.
4. Bushings for Floor-Mounted Equipment Anchors: Neoprene units designed for seismically rated rigid equipment mountings, and matched to type and size of anchor bolts and studs used.
5. Bushing Assemblies for Wall-Mounted Equipment Anchorage: Assemblies of neoprene elements and steel sleeves designed for seismically rated rigid equipment mountings, and matched to type and size of attachment devices used.

2.4 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 Division 5 Section "Metal Fabrications" for steel shapes and plates.

PART 3 – EXECUTION

3.1 APPLICATION

A. Comply with NECA 1 for application of hangers and supports for electrical equipment and systems, except if requirements in this Section are stricter.

B. Maximum Support Spacing and Minimum Hanger Rod Size for Raceway: Space supports for raceways as within 12 inches of coupling, fitting, and box, at each 90 degrees bend, minimum of two supports per ten foot run. Minimum rod size shall be 1/4 inch (6 mm) in diameter.

C. Multiple Raceways: Install trapeze-type supports fabricated with steel slotted or other 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, or as otherwise required by an agency acceptable to authorities having jurisdiction.

3.2 SUPPORT AND SEISMIC-RESTRAINT INSTALLATION:

A. Comply with NECA 1 for installation requirements, except as specified in this Article.

B. Raceway Support Methods: In addition to methods described in NECA 1, raceways may be supported by openings through structure members, as permitted in NFPA 70.

C. Install seismic-restraint components using methods approved by the evaluation service providing required submittals for component.

D. Strength of Support and Seismic-Restraint Assemblies: Where not indicated, select sizes of components so strength will be adequate to carry present and future static and seismic loads within specified loading limits. Minimum static design load used for strength determination shall be weight of supported components plus 200 lb (90 kg).

E. Mounting and Anchorage of Surface-Mounted Equipment and Components: Anchor and fasten electrical items and their supports to building structural elements by the following methods unless otherwise indicated by code:

1. To Wood: Fasten with lag screws or through bolts.
2. To New Concrete: Bolt to concrete inserts.
3. To Masonry: Approved toggle-type bolts on hollow masonry units and expansion anchor fasteners on solid masonry units.
4. To Existing Concrete: Expansion anchor fasteners.
5. Instead of expansion anchors, powder-actuated driven threaded studs provided with lock washers and nuts may be used in existing standard-weight concrete 4 inches (100 mm) thick or greater. Do not use for anchorage to lightweight-aggregate concrete or for slabs less than 4 inches (100 mm) thick.
6. To Steel: Beam clamps (MSS Type 19, 21, 23, 25, or 27) complying with MSS SP-69 Spring-tension clamps.
7. To Light Steel: Sheet metal screws.
8. Items Mounted on Hollow Walls and Nonstructural Building Surfaces: Mount cabinets, panelboards, disconnect switches, control enclosures, pull and junction boxes, transformers, and other devices on slotted-channel racks attached to substrate by means that meet seismic-restraint strength and anchorage requirements.

F. Drill holes for expansion anchors in concrete at locations and to depths that avoid reinforcing bars.

G. Do not drill or core cut holes for anchors or use powder-activated fasteners in post-tension slabs, joists, and beams.

3.3 INSTALLATION OF FABRICATED METAL SUPPORTS:

A. Comply with installation requirements in Division 5 Section "Metal Fabrications" for site-fabricated metal supports.

B. Cut, fit, and place miscellaneous metal supports accurately in location, alignment, and elevation to support and anchor electrical materials and equipment.

C. Field Welding: Comply with AWS D1.1/D1.1M.

3.4 CONCRETE BASES:

A. Concrete Bases: Anchor equipment to concrete base according to equipment manufacturer's written instructions and seismic criteria at Project.

B. Construct concrete bases of dimensions indicated but not less than 4 inches (100 mm) larger in both directions than supported unit, and so expansion anchors will be a minimum of 10 bolt

diameters from edge of the base.

1. Install dowel rods to connect concrete base to concrete floor. Unless otherwise indicated, install dowel rods on 18-inch (450-mm) centers around full perimeter of the base.
2. Install epoxy-coated anchor bolts for supported equipment that extend through concrete base, and anchor into structural concrete floor.
3. Place and secure anchorage devices. Use supported equipment manufacturer's setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
4. Install anchor bolts to elevations required for proper attachment to supported equipment.
5. Install anchor bolts according to anchor-bolt manufacturer's written instructions.
6. Use 5000-psi (34.5-MPa), 28-day compressive-strength concrete. Concrete materials, reinforcement, and placement requirements are specified in Division 3 Section "Cast-in-Place Concrete."

3.5 INSTALLATION OF SEISMIC-RESTRAINT COMPONENTS:

A. Install bushing assemblies for anchor bolts for floor-mounted equipment, arranged to provide resilient media between anchor bolt and mounting hole in concrete base.

B. Install bushing assemblies for mounting bolts for wall-mounted equipment, arranged to provide resilient media where equipment or equipment-mounting channels are attached to wall.

C. Restraint Cables: Provide slack within maximums recommended by manufacturer.

D. Attachment to Structure: If specific attachment is not indicated, anchor bracing to structure at flanges of beams, upper truss chords of bar joists, or at concrete members.

3.6 FIELD QUALITY CONTROL:

A. Testing Agency: Engage a qualified independent testing and inspecting agency to perform field tests and inspections and prepare test reports.

B. Testing: Test pullout resistance of seismic anchorage devices.

1. Provide evidence of recent calibration of test equipment by a testing agency acceptable to authorities having jurisdiction.
2. Schedule test with Owner, through Architect, before connecting anchorage device to restrained component (unless postconnection testing has been approved), and with at least seven days' advance notice.
3. Obtain Architect's approval before transmitting test loads to structure. Provide temporary load-spreading members.
4. Test at least four of each type and size of installed anchors and fasteners selected by Architect.
5. Test to 90 percent of rated proof load of device.
6. If a device fails test, modify all installations of same type and retest until satisfactory results are achieved.

C. Record test results.

END OF SECTION 26 00 72

SECTION 26 01 10 – CONDUIT RACEWAYS

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. This section is a Division 26 General Provisions section, and is part of each Division 26, 27, and 28 sections making reference to conduit raceways.

1.2 DESCRIPTION OF WORK:

A. Extent of raceways is indicated by drawings and schedules.

B. Types of raceways in this section include the followings:

1. Rigid Metal Conduit
2. PVC Externally Coated Rigid Steel Conduit
3. Intermediate Metal Conduit
4. Electrical Metallic Tubing
5. Flexible Metal Conduit
6. Liquid-tight Flexible Metal Conduit
7. Rigid Non-metallic Conduit

1.3 QUALITY ASSURANCE:

A. Standards: Refer to Section 260001 – Electrical General Provisions as applicable. Provide conduit raceway installation in accordance with recommendations of the American Iron and Steel Institute "Design Manual on Steel Electrical Raceways", latest edition.

B. Manufacturers: Firms regularly engaged in the manufacture of raceway of types and sizes required, whose products have been in satisfactory service for not less than three (3) years.

C. Shop Drawings: Not required.

PART 2 – PRODUCTS

2.1 CONDUITS:

A. Rigid Metal Conduit (RMC): Provide zinc-coated, hot-dipped galvanized, rigid metallic conduit in accordance with Federal Specification WW-C-0581 and ANSI C80.1.

B. PVC Externally Coated Rigid Metal Conduit: Provide hot-dipped galvanized, rigid metallic conduit externally coated with Polyvinyl Chloride (PVC) in accordance with ANSI C80.1 and NEMA Std. Pub. No. RN 1.

C. Intermediate Metal Conduit (IMC): Provide hot-dipped galvanized, intermediate metal conduit in accordance with Federal Specification WW-C-581.

D. Electric Metallic Tubing (EMT): Provide electric metal tubing in accordance with Federal Specification WW-C-563 and ANSI C80.3.

E. Flexible Metal Conduit: Provide zinc-coated, flexible metal conduit in accordance with Federal Specification WW-C-566.

F. Liquid-Tight Flexible Metal Conduit: Provide liquid-tight, flexible metal conduit, constructed of single strip, flexible continuous, interlocked, and double-wrapped steel, galvanized inside and outside, coated with liquid-tight jacket of flexible Polyvinyl Chloride (PVC).

G. Rigid Non-Metallic Conduit: Provide rigid non-metallic conduit (PVC) in accordance with ANSI/NEMA TC 2, Type 1 for concrete encasement, Type 2 for direct burial.

2.2 FITTINGS:

A. Rigid Metal Conduit, Intermediate Metal Conduit, and PVC Externally Coated Rigid Metal Conduit: Provide fully-threaded, malleable steel fittings, rain-tight and concrete-tight as applicable. Provide double locknuts and metal bushings at all conduit terminations. Install OZ Type B bushings on conduits 1-1/4" and larger.

B. Electric Metallic Tubing: Provide insulated throat, non-indenter, set screw, malleable steel fittings. Screws must have a full set. Provide concrete-tight compression-type fittings in suspended slabs. All EMT fittings shall be fabricated from steel. Die-cast fittings or fittings made from pot metal shall not be allowed. Indenter type fittings are not acceptable. Install OZ Type B bushings on conduits 1" and larger.

C. Flexible Metal Conduit: Provide flexible metal conduit fittings in accordance with Federal Specification W-F-406, Type 1, Class 1, and Style A. Commercial "greenfield" not less than 1/2" diameter or as otherwise specified on drawings is acceptable.

D. Liquid-Tight Flexible Metal Conduit: Provide liquid-tight flexible metal conduit fittings in accordance with Federal Specification W-F-406, Type 1, Class 3, Style G.

E. Non-Metallic Conduit: Provide non-metallic conduit fittings (PVC) in accordance with ANSI/NEMA TC 3 to match conduit types and materials.

F. Expansion Fittings: OZ Type AX, or equivalent to suit application.

G. Sealing Bushings: Provide OZ Type FSK, WSK, or CSMI as required by application. Provide OZ Type CSB internal sealing bushings.

H. Cable Supports: Provide OZ cable supports for vertical risers, type as required by application.

2.3 SIZES:

A. Provide conduits in sizes as indicated in contract documents or as otherwise specified herein, but not less than 3/4".

PART 3 – EXECUTION

3.1 GENERAL:

A. Install raceway and accessories 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.

3.2 LOCATIONS:

A. Rigid Metal Conduit and Fittings: Use for conduit bends greater than 22 degrees where buried below grade or slab on grade. Install RMC where raceway passes vertically through slab-on-grade. Where raceways penetrate building, manholes, or vault walls and floors below grade, provide RMC for a minimum distance of 10' on the exterior side of the floor or wall. Use RMC for exposed runs where conduit is subject to moisture, weather, or mechanical injury. Use in hazardous locations in accordance with all NEC requirements.

B. Intermediate Metal Conduit and Fittings: Use for exposed runs where conduit is subject to moisture, weather, or mechanical injury. Use in hazardous locations in accordance with all NEC requirements.

C. Electric Metal Tubing and Fittings: Use for above-grade feeders, branch circuits, and signal and control circuit, unless specifically noted otherwise on drawings. Install in suspended slabs subject to local code requirements and fire rating considerations.

D. Flexible Metal Conduit and Fittings: Use as whips for lighting fixtures, fixed equipment where not exposed to weather of moisture, other devices where required by NEC, and as requested by the Engineer. Maximum length not to exceed 6', unless specifically approved by the Electrical Engineer.

E. Liquid-Tight Flexible Metal Conduit and Fittings: Use for connection to motor terminal boxes, fixed equipment where subject to moisture or weather, and other equipment subject to movement or vibration. Maximum length not to exceed 6', unless specified otherwise.

F. Rigid Non-Metallic Conduit and Fittings: Use for below-grade service entrances, feeders, branch circuits, and signal and control circuit, unless specifically noted otherwise on drawings. Do not use above grade.

3.3 METHODS:

A. Maintain a minimum of 12" clearance between steam or hot water lines or other hot surfaces. Where such clearance is impractical, insulate conduit with approved materials.

B. Install conduits parallel with or at right angles to lines of the structure. Route conduits symmetrically where possible.

C. Field bends and offsets shall be made without flattening, kinking, rippling or destroying the smooth internal bore or surface of the conduit and to not less than NEC minimum radius. Conduit that shows signs of rippling or kinking shall not be installed. Conduits installed with wrinkles or kinks or otherwise in an unworkmanlike manner shall be replaced at no additional cost to owner.

D. Precaution shall be exercised to prevent accumulation of water, dirt or concrete in the conduits during the execution of the project. Conduits in which water or foreign matter has been permitted to accumulate shall be thoroughly cleaned or the conduits runs replaced where such accumulation cannot be removed by methods approved the engineer.

E. Any conduit which pierces airtight spaces or plenums shall be sealed to prevent air leakage with mastic acceptable to the Architect.

3.4 CONCEALING:

A. All raceways shall be concealed within the ceilings, walls, and floors, except in locations where exposed raceways are specifically permitted, such as equipment rooms and unfinished storage areas. In equipment rooms, if lighting raceways are run exposed, installation shall not be done until piping and duct work layout has been determined in order that lighting boxes may be located so as to avoid being covered by overhead ducts and piping. If lighting raceways in equipment rooms are concealed in the structural ceiling slab, after mechanical work is complete, exposed conduit extensions shall be run to locate lighting fixtures where they are not obscured by work of other trades.

3.5 BURIED CONDUITS:

A. Comply with all burial depths as defined in NEC Section 300-5. Bury all conduits at least 24" below grade, unless specifically indicated otherwise on drawings. Provide magnetic 6" wide “Yellow Warning" ribbon 12" directly above conduit and 6" below finished grade measured from the top of the conduit or duct bank. Where multiple small lines are buried in a common trench and do not exceed an overall width of 16", install a single marker.

B. Slope all conduits toward manholes or pull boxes for proper drainage. Use weep holes. Gravel drainage pockets are not permitted.

C. Coat all metal conduits with an approved asphaltic compound or wrap with two layers of PVC tape.

D. Under Concrete Slab on Grade: Horizontal conduit must be installed a minimum of 6” below the bottom of the concrete slab. Conduits should not be installed in concrete slabs.

E. Where conduits are extended for future use, cap and clearly mark.

3.6 ELECTRICAL CONTINUITY:

A. Provide electrically continuous conduit systems throughout.

3.7 FIELD CUTS AND THREADS:

A. Cut all conduits square. Remove all sharp or rough edges and ream all burrs, inside and outside. Provide clean sharp threads on RMC and IMC.

B. Engage at least five full threads on all RMC and IMC fittings. Before couplings or fittings are attached, apply one coat of red lead or zinc chromate to male threads of RMC or IMC. Apply coat of red lead, zinc chromate or special compound recommended by manufacture to conduit where conduit protective coating is damaged.

3.8 CONDUIT ENDS:

A. Cap all spare conduits. Cap or plug conduit ends during construction to prevent entrance of foreign material.

3.9 SPARE CONDUITS:

A. Provide five (5) 3/4" empty conduits from panel stubbed into accessible ceiling space and five (5) 3/4" conduits into accessible floor space. When floor is not accessible, provide six (6) 3/4" empty conduits from panel stubbed into accessible ceiling space. Cap and label all conduits.

B. Install a 200 lb. polypropylene pull cord in each empty conduit run.

3.10 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; raceway shall be PVC or RMC. All elbows shall be long-radius PVC, RMC, or fiberglass elbows complying with all ESR requirements. Sleeve conduits when conduit extends vertically through a paved surface. 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. The contractor shall provide trenching, boring, backfill, compactions, and surface repair.

D. The contractor shall provide pre-case concrete pad/vaults for utility provided transformers as required.

E. The contractor shall provide concrete pads for utility provided transformers as required.

F. Install RMC and IMC in all hazardous locations as defined by the NEC. Provide suitable fittings, seal-offs, boxes, etc. to comply with all NEC requirements and/or as shown on the drawings. Provide inspection fittings with hazardous location rated drains to prevent water from accumulating in conduit runs.

3.11 CLEANING:

A. Pull mandrel and swab through all conduits before installing conductors.

END OF SECTION 26 01 10

SECTION 26 01 20 – CONDUCTORS AND CABLES

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. This section is a Division 26 General Provisions section, and is part of each Division 26, 27, and 28 sections making reference to conductors and cables.

1.2 DESCRIPTION OF WORK:

A. This section includes building wires and cables and associated connectors, splices, and terminations for wiring systems rated 600 V and less.

B. Types of conductors and cables in this section include the following:

1. Copper Conductors.
2. Aluminum Conductors.
3. MC Flexible Metal Clad Copper Cables.
4. PV Photovoltaic Copper Cables.
5. Flexible Cords.

C. Applications for conductors and cables required for project include:

1. Electrical service.
2. Feeders.
3. Branch Circuits.

1.3 SUBMITTALS:

A. Product Data: For each type of conductor and/or cable indicated.

B. Field Quality-Control Test Reports: From Contractor. Refer to Section 260001 – General Electrical Provisions.

1.4 QUALITY ASSURANCE:

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

B. Comply with NFPA 70.

PART 2 – PRODUCTS

2.1 GENERAL:

A. Manufacturers: In other Part 2 articles where subparagraph titles below introduce lists, provide products by the manufacturer specified, subject to compliance with requirements.

B. Ambient Conditions: Conductors used for branch circuits in areas where the ambient conditions exceed 30 degree C. shall be provided with insulation approved for that temperature.

C. Wire Sizes: As indicated on electrical drawings or as specified herein, but in no case less than No. 12 AWG.

2.2 COPPER CONDUCTORS:

A. Manufacturers:

1. Cerro Wire & Cable Company.
2. General Cable Technologies Corporation.
3. Encore Wire Corporation.
4. Southwire Incorporated.

B. Refer to Part 3 "Conductor and Cable Applications" Article for application requirements.

C. References and Ratings:

1. ICEA S-95-658 / NEMA WC70.
2. ASTM.
3. UL Standard 83.
4. UL Standard 1063 (MTW).
5. Federal Specification J-C-30B.
6. NEC.

D. Conductor Material: Copper.

E. Stranding: Solid conductor for No. 12 AWG, stranded for No. 10 AWG and larger.

F. Conductor Insulation Types: Thermoplastic-insulated, Type THHN / THWN-2.

2.3 ALUMINUM CONDUCTORS:

A. Manufacturers:

1. Alcan Aluminum Corporation; Alcan Cable Div.

B. Refer to Part 3 "Conductor and Cable Applications" Article for application requirements.

C. References and Ratings:

1. ICEA S-95-658 / NEMA WC70.
2. Federal Specification J-C-30B.
3. ASTM Standards B 800 and B 801.

D. Conductor Material: Aluminum.

E. Stranding: STABILOY compact stranded conductor (AA-8000 Series aluminum alloy).

F. Conductor Insulation Types: Black cross-linked polyethylene (XLPE), Type XHHW-2.

2.4 MC FLEXIBLE METAL CLAD COPPER CABLES:

A. Manufacturers:

1. AFC Cable Systems, Inc.

B. Refer to Part 3 "Conductor and Cable Applications" Article for application requirements.

C. References and Ratings:

1. UL 83, 1479, 1569, 1581, File Reference E80042.
2. NEC 230-43, 300-22(c), 318, 321, 334, 518, 520, 530, 645.
3. Federal Specifications J-C-30B.
4. Meets all applicable OSHA and HUD requirements.
5. May be surface-mounted or embedded in plaster.
6. UL rated for Cable Tray and Environmental Air-Handling Space installation; 1, 2 and 3-hour through-penetration Fire Wall rated.

D. Conductor Material: Copper.

E. Stranding: Solid conductor for No. 10 AWG and smaller, stranded for No. 8 AWG and larger.

F. Conductor Insulation Types: Type THHN.

G. Armor: Galvanized steel.

H. Assembly Covering: Mylar Tape.

I. Grounding: Insulated green grounding conductor.

2.5 PHOTOVOLTAIC COPPER CABLE

A. Description: Flexible, insulated and uninsulated, drawn copper current-carrying conductor with an overall insulation layer or jacket, or both, rated 2000 V and/or 600 V as applicable for the installation.

B. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Encore Wire Corporation.
2. General Cable; General Cable Corporation
3. Service Wire Co.
4. Southwire Company.

A. Standards:

1. Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and use.
2. RoHS compliant.
3. Conductor and Cable Marking: Comply with wire and cable marking according to UL's "Wire and Cable Marking and Application Guide."

B. Conductors: Copper, complying with ASTM B3 for bare annealed copper and with ASTM B8 for stranded conductors.

C. Conductor Insulation: Comply with UL 44 and UL 4703.

2.6 FLEXIBLE CORDS:

A. Manufacturers:

1. Cerro Wire & Cable Company.
2. General Cable Technologies Corporation.
3. Encore Wire Corporation.
4. Southwire Incorporated.

B. Refer to Part 3 "Conductor and Cable Applications" Article for application requirements.

C. References and Ratings:

1. ASTM.
2. ICEA.
3. UL 62.
4. Pendant or portable.
5. Damp locations.
6. 600 Volts.
7. NEC Article 400.

D. Conductor Material: Copper.

E. Stranding: Class K, flexible stranded conductor.

F. Conductor Insulation Types: Heat- and moisture-resistant TPE insulation.

G. Fillers and Wrapping: Non-wicking polypropylene fillers, with tissue-paper separator wrapped around the assembly.

H. Outer Jacket: Black-colored, heat-, moisture-, and oil-resistant TPE jacket.

I. Grounding: Insulated green grounding conductor.

J. Cord Type: SO, hard-usage.

2.7 CONNECTORS AND SPLICES:

A. Manufacturers:

1. AFC Cable Systems, Inc.
2. AMP Incorporated/Tyco International.
3. Hubbell/Anderson.
4. O-Z/Gedney; EGS Electrical Group LLC.
5. 3M Company; Electrical Products Division.

B. Description: Factory-fabricated connectors and splices of size, ampacity rating, material, type, and class for application and service indicated.

C. Splices for wire sizes #10 and smaller shall be screw-on type similar to scotch or ideal wing nut connectors. Crimp-on splices designed to be used without wire stripping are not acceptable.

PART 3 – EXECUTION

3.1 GENERAL:

A. Install conductors, cables, and accessories as indicated, in compliance with manufacturer's written instruction, applicable requirements of NEC, NECA's "Standards of Installation", and in accordance with recognized industry practices to ensure that products fulfill requirements.

3.2 CONDUCTOR AND CABLE APPLICATIONS:

A. Service Entrance: As indicated on the electrical drawings.

B. Feeders: As indicated on the electrical drawings with the exception that all emergency feeders that are not installed in space that are fully protected by an approved automatic fire suppression system shall be MI Mineral Insulated Copper Cables; this includes locations such interstitial spaces above fire suppression system sprinklers.

C. Branch Circuits:

1. Exposed, including in crawlspaces: Copper conductors in raceway.
2. Concealed in ceilings, walls, and partitions: Copper conductors in raceways.
3. Concealed in ceilings, walls, and partitions: Copper conductors in homerun raceways from electrical panelboards to first outlet box; MC flexible metal clad copper cables are allowed for connection of wiring devices, light fixtures, and equipment at load end and in dry and concealed locations only.
4. Concealed in concrete and below slabs-on-grade: Copper conductors in raceway.

D. Cord Drops, Reels, and Portable Appliance Connections: Flexible cord.

E. PV Circuits: PV Copper Conductors in raceway.

3.3 INSTALLATION:

A. Conceal cables in finished walls, ceilings, and floors, unless otherwise indicated.

B. 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.

C. Use pulling means; including fish tape, cable, rope, and basket-weave wire/cable grips that will not damage cables or raceway.

D. When raceway is not required, install concealed cables parallel and perpendicular to surfaces of structural members, and follow surface contours where possible.

E. Support cables according to other applicable specification sections.

F. Seal around cables penetrating fire-rated elements to comply with applicable fire stop specification sections.

G. Color Coding: Color code secondary service, feeder, and branch circuit conductors. Colors shall remain consistent throughout the project and shall match existing coding system where applicable.

1. Conductor sizes No. 6 AWG and smaller: Colored insulation.
2. Conductors sizes No. 4 AWG and larger: 2 inch (51 mm) band of Colored adhesive marking tape applied at all terminations, junction boxes, and pull boxes.

3. Branch circuit switched-legs and travelers: Colored insulation (in colors other than those indicated below).
4. Color-code 120/208V system conductors:
   A. Phase A: Black.
   B. Phase B: Red.
   C. Phase C: Blue.
   D. Neutral A: White with Black stripe.
   E. Neutral B: White with Red stripe.
   F. Neutral C: White with Blue stripe.
   G. Neutral (Shared when allowed): White
   H. Ground: Green.
   I. Isolated Ground: Green with yellow tracer.
5. Color-code 277/480V system conductors:
   A. Phase A: Brown.
   B. Phase B: Orange.
   C. Phase C: Yellow.
   D. Neutral A: Gray with Brown stripe.
   E. Neutral B: Gray with Orange stripe.
   F. Neutral C: Gray with Yellow stripe.
   G. Neutral (Shared when allowed): Gray.
   H. 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 (a, b, or c).
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 (a or b).

3.5 NEUTRAL CONDUCTORS:

A. LINE-TO-NEUTRAL BRANCH CIRCUITS: 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.

3.6 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. Calculations shall be based on the following:

1. Lighting Branch Circuits: Connected load plus 25% spare.
2. Appliance and Equipment Branch Circuits: Nameplate or NEC required load.
3. 120V Convenience Outlet Branch Circuits: 12 amps minimum, but in no case less than NEC loading requirements. Use the following schedule:

Distance (feet)	Wire Size (AWG)

0-80	#12
81-125	#10
126-200	#8
201-320	#6

4. Use the NEC method to calculate voltage drop.

3.7 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 and UL 486B.

B. Make splices and taps that are compatible with conductor material and that possess equivalent or better mechanical strength and insulation ratings than unspliced conductors.

C. Use oxide inhibitor in each splice and tap conductor for aluminum conductors.

D. Wiring at Outlets: Install conductor at each outlet, with at least 6 inches (150 mm) of slack. Use pig tails when wiring outlets.

3.8 FIELD QUALITY CONTROL:

A. Testing: Perform the following field quality-control testing:

1. Visual and Mechanical Inspection:
   A. Inspect cables for physical damage and proper connection in accordance with the electrical construction documents.
   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.
   B. Perform continuity test to insure proper cable connection.
3. Test Values:
   A. Minimum insulation resistance values shall not be less than two megaohms.
4. Infrared Scanning: After Substantial Completion, but not more than 60 days after Final Acceptance, perform an infrared scan of each splice in conductors No. 3 AWG and larger. Remove box and equipment covers so splices are accessible to portable scanner. Correct deficiencies determined during the scan.
   a. Follow-up Infrared Scanning: Perform an additional follow-up infrared scan of each splice 11 months after date of Substantial Completion.
   b. Instrument: Use an infrared scanning device designed to measure temperature or to detect significant deviations from normal values. Provide calibration record for device.
   c. Record of Infrared Scanning: Prepare a certified report that identifies splices checked and that describes scanning results. Include notation of deficiencies detected, remedial action taken, and observations after remedial action.

B. Test Reports: Prepare a written report and submit to the Electrical Engineer at the completion of the project. The report shall include the following:

1. Test procedures used.

2. Test results that comply with requirements.
3. Test results that do not comply with requirements and corrective action taken to achieve compliance with requirements.

END OF SECTION 26 01 20

SECTION 26 01 35 – ELECTRICAL BOXES AND FITTINGS

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. This section is a Division 26 General Provisions section, and is part of each Division 26, 27, and 28 sections making reference to electrical boxes and fittings.

1.2 DESCRIPTION OF WORK:

A. Extent of electrical boxes and fittings work is indicated by drawings and schedules.

B. Types of electrical boxes and fittings in this section include the following:

1. Outlet Boxes
2. Junction Boxes
3. Pull Boxes
4. Floor Boxes
5. Conduit Bodies
6. Bushings
7. Locknuts
8. Knockout Closures
9. Miscellaneous Boxes and Fittings

1.3 QUALITY ASSURANCE:

A. Standards: Refer to Section 260001 – Electrical General Provisions as applicable.

B. Manufacturers: Firms regularly engaged in the manufacturer of boxes and fittings required, whose products have been in satisfactory service for not less than three years.

C. Shop Drawings: Submit shop drawings on floor boxes only where required.

PART 2 – PRODUCTS

2.1 INTERIOR OUTLET BOXES:

A. General: Provide one piece, galvanized or cadmium-plated, flat-rolled, sheet steel interior outlet boxes of types, shapes, and sizes to suit respective location and installation. Construct with stamped knockouts on back and sides and with threaded screw holes. Provide corrosion-resistant screws for securing boxes, covers, and wiring devices. Size all junction boxes in accordance with NEC Table 314.16(A), with a minimum box size of 4" x 4" x 1-1/2". Where three raceway entries are made, provide outlet boxes with a minimum depth of 2-1/8". Where four or more raceway entries are made, provide outlet boxes with a minimum depth of 4-11/16". Gangable boxes shall not be used.

B. Switch, Telephone, and Receptacle Outlets: Provide outlet boxes not less than 4" square, with adapting tile or plaster covers where necessary to set flush with finished surfaces. Where three raceway entries are made, provide outlet boxes with a minimum depth of 2-1/8". Gang boxes shall be used where more than one switch or device is located at one point. Sectional Boxes are not acceptable. In masonry walls where tile or plaster ring cannot be used, install a single-gang 3-1/2" deep box minimum, unless otherwise noted. Where four or more raceway entries are made, provide outlet boxes with a minimum depth of 4-11/16".

C. Lighting Outlets:

1. Lay-in Grid: Outlets for recessed fixtures in acoustical tile ceilings shall be located to center on a single tile or at the intersection of four tiles.
2. Surface-mounted: Provide 4" square octagonal outlet boxes for surface-mounted, ceiling fixture outlets. Mount each box independently of the conduit on standard 3/8" stud or approved box hangar where applicable. Include backing and supports as required to carry 200 lbs. Where three or more raceway entrances are made, use a minimum box depth of 2-1/8".

2.2 WEATHERPROOF OUTLET BOXES:

A. Provide corrosion-resistant, cast-metal weatherproof outlet boxes, of types, shapes, and sizes, with threaded conduit ends, cast metal coverplates with spring-hinged waterproof caps, face plate gaskets, and corrosion-resistant fasteners.

2.3 JUNCTION AND PULL BOXES:

A. Provide code-gauge sheet steel junction and pull boxes, with removable screw-on covers and welded seams, of types, shapes, and sizes to suit each respective location and installation. Size all junction and pull boxes in accordance with NEC 314.28. Provide stainless steel nuts, bolts, screws, and washer.

2.4 FLOOR BOXES:

A. Provide steel or PVC, weatherproof, concrete-tight floor boxes of types, shapes, and sizes to suit each respective location and installation. Where multi-service floor boxes are indicated, provide floor boxes sized to accommodate wiring devices and communication outlets shown on drawings. Construct floor boxes with fully adjustable leveling screws, and knockouts as required to accommodate specified conduits.

B. Provide floor boxes from the following manufacturers:

1. Bell Electric
2. Crouse-Hinds
3. Hubbell
4. Steel City
5. Thomas&Betts
6. Wiremold

2.5 CONDUIT BODIES:

A. Provide galvanized, cast-metal conduit bodies of type, shapes, and sizes to suit respective locations and installation. Construct with threaded conduit entrance ends and removable covers. Provide corrosion-resistant screws.

B. Aluminum boxes and fitting shall not be permitted.

2.6 CONDUIT CONNECTIONS:

A. Box connectors 3/4" and larger shall be insulated, throat-type or equal type plastic bushings. Provide double locknuts and insulating plastic bushings for RMC and IMC terminating at panels and boxes.

B. Where RMC penetrates building, manholes, or vault walls and floors below grade, provide sealing bushings with external membrane clamps as applicable. Provide segmented internal sealing bushings in all raceways penetrating building walls and slabs below grade, and in all above grade raceway penetrations susceptible to moisture migration into building through raceway. Where RMC terminates in manhole, vault, or pull box, provide insulated grounding bushings. Also see Section 260135 – Electrical Boxes and Fittings.

C. Install OZ type "B" connectors for all conduits 1" and larger.

D. Provide cable supports in all vertical risers in accordance with NEC 300-19.

2.7 EXPANSION FITTINGS:

A. Provide expansion joint fittings in all conduit runs crossing structural expansion joints, whether above-grade, in slab-on-grade, or in suspended slabs. Provide OZ type "AX" or approved equivalent, size to the raceway.

2.8 ACCESSORIES:

A. Provide all accessories including, but not necessarily limited to, bushings, knockout closures, locknuts, offset connectors, etc. of types, shapes, and sizes to suit respective locations and installation. Construct of corrosion-resistant steel.

PART 3 – EXECUTION

3.1 GENERAL:

A. Install electrical boxes and fittings in accordance with manufacturer's written instruction, applicable requirements of the NEC, NEMA Standards, and NECA's "Standards of Installation", and in compliance with recognized industry practices to ensure that products fulfill requirements.

3.2 METHODS:

A. Where outlet boxes are subject to weather or moisture, install weatherproof outlet boxes.

B. Remove knockouts only for entering conduits. Provide knockout closures to cap unused knockout holes where blanks are mistakenly removed.

C. Do not use condulets in place of elbows or junction boxes. Condulets in sizes 2" or larger shall not be used, unless specifically approved by the electrical engineer.

D. Install boxes and conduit bodies in readily accessible locations. Install recessed boxes with faces of boxes or rings flush with finished surfaces. Seal all openings between outlet box and adjacent surfaces with plaster, grout, or similar suitable material.

E. For stud construction, install boxes with rigid supports using metal bar hangers, or 2" X 4", 1" X

6" wood bridging between studs with screws. Welding or nailing boxes directly to metal joist and studs is not acceptable. Boxes set opposite in common wall shall have at least 10" of conduit between them. Securely fasten outlet boxes to structural surfaces to which attached.

F. For concrete or masonry construction, solidly embed electrical boxes in concrete and masonry. Provide box supports as required to keep outlet boxes flush with finished surfaces.

G. Coordinate location of all outlet boxes with millwork, back splashes, tackboards, etc.

H. Install junction boxes or condulets in conduit runs as required at 100 foot maximum intervals on long runs. This shall apply to concrete junction boxes in grade and junction boxes within the building.

I. Provide electrical connections for installed boxes.

3.3 IDENTIFICATION:

A. Mark circuit number on exterior side of junction boxes located in ceilings such that circuits numbers are readily identifiable. For outlet boxes in wall, mark circuit numbers on interior sides of outlet boxes.

B. Identification labels shall be as follows:

Normal Power	Black with White letters

END OF SECTION 26 01 35

SECTION 26 01 40 – WIRING DEVICES

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. This section is a Division 26 General Provisions section, and is part of each Division 26, 27, and 28 sections making reference to wiring devices.

1.2 DESCRIPTION OF WORK:

A. Extent of wiring device work is indicated by drawings and schedules.

B. Types of electrical wiring devices in this section include the following:

1. Toggle Switches
2. Receptacles
3. Floor Service Outlets
4. Special Purpose Outlets
5. Cord Caps and Connectors

1.3 QUALITY ASSURANCE:

A. STANDARDS: Refer to Section 26 0001 – Electrical General Provisions as applicable.

B. SHOP DRAWINGS:

1. Submit manufacturer's data on all electrical wiring devices.
2. Where occupancy sensors are required, provide scaled drawing showing manufacturer's recommended locations.

PART 2 – PRODUCTS

2.1 GENERAL:

A. Provide factory-fabricated wiring devices, in types, and electrical ratings for applications indicated and complying with NEMA standards Pub No. WD 1; nylon construction, 20 amp rating minimum.

B. Provide wiring devices in colors selected by Architect/Engineer. Provide red receptacle outlets where devices are circuited to standby power.

2.2 TOGGLE SWITCHES:

A. Provide toggle switches from one of the following manufacturers (Fed-Spec):

Manufacturer	1-Pole	3-Way	4-Way	W/Pilot

Hubbell	HBL1221	1223	1224	1221-PL
Pass & Seymour	20AC1	20AC3	20AC4	20AC1-RPL
Leviton	1221	1222	1223	1221-PLR
Cooper	2221	2223	2224	2221-PL
Bryant	4901	4903	4904	4901-PL

B. Abbreviations are defined as follows:

1. 1-Pole - Single-Pole Toggle Switch
2. 3-Way - Three-Way Toggle Switch
3. 4-Way - Four-Way Toggle Switch
4. W/Pilot - Single-Pole Toggle Switch with Pilot Light

C. Must be back and side wired, and have color-coded covers, Brass terminal screws, back wire ground clamp, and self-grounding clip.

2.3 RECEPTACLES:

A. Provide heavy-duty, straight-blade, tamper-resistant, specification-grade, 20-amp duplex receptacles from one of the following manufacturers:

Basis-of-Design Manufacturer	CO	GFCI
Hubbell	HBL5362_TR	GFTRST20_

Equivalent products from Pass & Seymour and Cooper are also acceptable.

B. Where duplex receptacles are shown with an “H” subscript on the electrical drawings, provide heavy-duty, straight-blade, tamper-resistant, specification-grade, hospital-grade, 20-amp duplex receptacles from one of the following manufactures:

Basis-of-Design Manufacturer	CO	GFCI
Hubbell	8300_TRA	GFTRST83_

Equivalent products from Pass & Seymour and Cooper are also acceptable.

C. Abbreviations are defined as follows:

1. CO- Convenience Outlet Duplex Receptacle
2. GFCI- Ground Fault Circuit Interrupter duplex Receptacle
3. IG- Isolated Ground Duplex Receptacle

D. Must have one-piece Brass back strap and back wire grounding clamp (Does not apply to GCFI or isolated ground).

2.4 FLOOR SERVICE OUTLETS:

A. Provide all receptacles and special purpose outlets required in floor boxes. See Section 26 0135 – Electrical Boxes and Fittings. Provide coverplates, carpet flanges, etc. in finishes or colors selected by Architect/Engineer.

2.5 SPECIAL PURPOSE OUTLETS:

A. Provide special purpose outlets of voltage and ampere ratings, and NEMA configurations to suit respective application. Refer to drawings for NEMA configuration. Provide special purpose outlets in amperages at least as large as the overcurrent protective device from which they are served.

2.6 CORD CAPS AND CONNECTORS:

A. Provide cord caps and connectors of voltage and ampere ratings, and NEMA configurations which mate and match with outlets specified as required for final connections for equipment. Provide cord caps and connectors of one of the following:

1. Hubbell
2. Pass & Seymour
3. Leviton
4. Cooper
5. Bryant

2.7 COVERPLATES:

A. Wall Plates: Provide coverplates for all wiring devices. In all finished areas, provide nylon or high impact resistant thermoplastic coverplates in colors as selected by Architect. Provide red coverplates for all receptacle outlets and toggle switches that are circuited to emergency power. Provide orange coverplates for all isolated ground receptacle outlets. Provide stainless steel coverplates in commercial kitchens and food preparation areas. Provide ganged coverplates for all switches and/or dimmers. Provide pre-marked coverplates for special purpose outlet indicating voltage, amperages, and phase. Provide raised stamped, galvanized, steel plates in all unfinished areas. Provide weather-proof coverplates for outlets exposed to weather and moisture.

B. Weather-Protecting Device Enclosure: Where required for compliance with NEC 410-67 (receptacles installed outdoors for use other than with portable tools or equipment), provide weather-tight device covers which provide complete protection with the cord and cap inserted into the wring device. Provide units which mount on either single or double gang devices. Provide device enclosures manufactured by one of the following:

1. Intermatic WP1020 or WP1030
2. Hubbell WP826MP
3. Pass & Seymore

PART 3 – EXECUTION

3.1 GENERAL:

A. Install wiring devices and accessories in accordance with manufacturer's written instruction, applicable requirements of the NEC, NEMA Standards, and NECA's "Standards of Installation", and in compliance with recognized industry practices to insure that products fulfill requirements.

3.2 METHODS:

A. Install wiring devices only in electrical boxes which are clean and free from excess building materials, dirt, and debris. Do not install wiring devices until painting work is completed.

B. Replace receptacles and/or coverplates which are damaged, stained, or burned.

3.3 GFCI RECEPTACLES:

A. Provide separate neutral conductor from panel to each GFCI receptacle circuits.

B. Install GFCI receptacles for all receptacles installed in restrooms, outdoors, or within six feet of any sink. All receptacles in kitchens shall be GCFI protected.

C. Do not wire standard receptacles on the load side of GFCI receptacle - Install GFCI receptacles.

3.4 GROUNDING:

A. Provide electrical continuous, tight, grounding connections for wiring devices.

3.5 TESTING:

A. Prior to energizing circuitry, test wiring devices for electrical continuity and proper polarity connections. After energizing circuitry, test wiring devices to demonstrate compliance with requirements.

3.6 IDENTIFICATION:

A. All devices shall be identified on the cover plate with the panel board name and the circuit number by a black on clear adhesive label.

B. In each outlet, tag each wire to identify the circuit it serves.

END OF SECTION 26 01 40

SECTION 26 01 55 – MOTOR STARTERS

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. This section is a Division 26 General Provisions section, and is part of each Division 26, 27, and 28 sections making reference to motor starters.

1.2 DESCRIPTION OF WORK:

A. Extent of motor starter work is indicated by drawings and schedules.

B. Type of motor starters in this section include the following:

1. Fractional Horsepower Manual Starters
2. Integral Horsepower Manual Starters
3. Non-Reversing Magnetic Starters
4. Two-Speed Non-Reversing Magnetic Starters
5. Combination Non-Reversing Magnetic Starters

1.3 QUALITY ASSURANCE:

A. STANDARDS: Refer to Section 260001 – Electrical General Provisions as applicable.

B. SUBMITTALS:

1. Shop Drawings: Submit manufacturer's data and dimensional details on motor starters including voltage, controller size, ratings and size of switching and overcurrent protective devices, short circuit ratings, dimensions, and enclosure details.
2. Manufacturer's Installation Instructions: Indicate application conditions and limitations of use stipulated by product testing agency specified under regulatory requirements. Include instructions for storage, handling, protection, examination, preparation, installation, and starting of products.

PART 2 – PRODUCTS

2.1 GENERAL:

A. Manufacturers: Subject to compliance with all requirements, provide products of on of the following:

1. ABB / General Electric
2. Cutler-Hammer
3. Siemens
4. Square D

B. Maintenance, Stock, Fuses: For types and ratings required, furnish additional fuses, amounting to one unit for every 10 installed units, but not less than 3 units of each, for both power and control circuit fuses.

2.2 THERMAL OVERLOAD UNITS:

A. Provide metal alloy, thermal overload units for all motor starters. Size to actual running full load current, not to motor plate current, after air and water balancing are completed.

2.3 FRACTIONAL HORSEPOWER MANUAL STARTERS:

A. Provide fractional horsepower manual starters for single-phase fractional horsepower motors up to and including 1 horsepower, equivalent to Square D Class 2510, Type F, of types, sizes, and electrical characteristics required to suit applications or as otherwise indicated on drawings. Provide NEMA ICS 2, AC general-purpose Class A manually operated, full-voltage starter, with thermal overload units, red pilot light, and toggle operator with handle guard/lock-off. Provide ANSI/NEMA ICS 6, Type 1 enclosures, or where subject to weather or moisture, Type 3R.

PART 3 – EXECUTION

3.1 GENERAL:

A. Install motor starters in accordance with manufacturer's written instructions, applicable requirements of the NEC, NEMA standards, and NECA's "Standards of Installation", and in compliance with recognized industry practices.

3.2 METHODS:

A. Install overload units so catalog number is visible. Mount chart inside each starter indicating heater type, size, and ampere ratings available.

B. Where sizes of starters, disconnect, fuses, motor circuit protectors, heaters, etc. are not indicated on drawings, size all equipment in accordance with manufacturer's written instructions.

C. Submit with the record drawings a record of the motor amperage readings of each electrically-driven unit; show horsepower, full-load amps and service factor.

3.3 IDENTIFICATION:

A. Provide 1/16" thick black plastic laminate labels with 1/4" high lettering on the exterior of each starter cabinet. Provide red plastic laminate label for starter supplied by emergency power. Include mechanical equipment designation, horsepower, voltage, full-load amps, and service factor of motor. Mark on interior cover the source of power by indicating the panel and circuit number.

3.4 MOTOR CONNECTIONS:

A. Each motor shall be connected to the conduit with a length of flexible, seal-tight conduit (minimum of 18"), with proper type fittings. All motor supply circuits shall include a green ground conductor. Check for proper motor rotation on all motors or equipment.

END OF SECTION 26 01 55

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Community School

SECTION 26 01 60 – PANELBOARDS

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. This section is a Division 26 General Provisions section, and is part of each Division 26, 27, and 28 sections making reference to panelboards.

1.2 DESCRIPTION OF WORK:

A. Extent of panelboard work is indicated by drawings and schedules and is specified herein.

B. Type of panelboards in this section include the following:

1. Lighting and Appliance Panelboards
2. Power Distribution Panelboards

1.3 QUALITY ASSURANCE:

A. STANDARDS: Refer to Section 260001 – Electrical General Provisions as applicable.

B. SUBMITTALS:

1. Shop Drawings: Submit dimensioned drawings of panelboards and enclosures showing accurately scaled layouts of enclosures. Include schedule of devices, including, but not necessarily limited to, circuit breakers, fusible switches, fuses, ground-fault circuit interrupters, and accessories.
2. Equipment Room Layouts: Submit dimensioned drawings of all equipment rooms indicating spatial relationships to other proximate equipment. Insure that all code required clearances are maintained.

PART 2 – PRODUCTS

2.1 MANUFACTURERS:

A. Subject to compliance with all requirements, provide products from one of the follows:

1. Cutler-Hammer, Eaton Corp.
2. General Electric Co. / ABB
3. Siemens Energy & Automation, Inc.
4. Square D Co.

2.2 GENERAL:

A. Provide panelboards, enclosures, and ancillary components, of types, sizes, and ratings indicated. Provide overcurrent protective devices, etc. as indicated on drawings for a complete

installation.

B. Where "Spaces" or "Blanks" are indicated on panelboard schedules, provide drilled bus and mounting hardware ready to receive breaker or fusible switch of size indicated on panelboard schedule.

2.3 PANELBOARD ENCLOSURES:

A. Provide Code gauge, galvanized or rust-resistant sheet steel enclosures in sizes and NEMA types to suit respective applications. The size of the wiring gutters and gauge of steel shall be in accordance with the latest NEMA Standards Publication and latest UL standards for panelboards. Flush locks shall not protrude beyond the front of the door. Key all enclosures alike and provide three keys at completion of the project. Fronts shall have adjustable indicating trim clamps, which shall be completely concealed when the doors are closed. Doors shall be mounted by completely concealed steel hinges. A circuit directory frame and card, with clear plastic covering shall be provided on the inside of the door. The directory cards shall be typewritten to identify each circuit service. Provide panel enclosures with doors hinged to enclosures. Provide ANSI-61 painted finish.

2.4 LIGHTING AND APPLIANCE PANELBOARDS:

A. Provide dead-front, safety-type lighting and appliance panelboards of types and electrical characteristic indicated. Provide aluminum bus bars, full-sized neutral bus, and ground bus. Provide insulated/isolated ground buses where indicated. Include overcurrent protective devices and switches in quantities, ratings, types, and arrangements shown. See Section 260180 – Overcurrent Protective Devices.

B. Rate devices, bussing, supports, etc. equal to or greater than the short circuit current rating indicated. Provide fully-rated systems only. Series-rated systems are not acceptable, unless specifically noted otherwise.

2.5 POWER DISTRIBUTION PANELBOARDS:

A. Provide dead-front, safety-type lighting and appliance panelboards of types and electrical characteristic indicated. Provide wall-mounted or floor-standing power distribution panelboards as indicated. Provide panelboards suitable for use as service equipment where required. Provide aluminum bus bars, full-sized neutral bus, and ground bus. Provide insulated/isolated ground buses where indicated. Include overcurrent protective devices and switches in quantities, ratings, types, and arrangements shown. See Section 260180 – Overcurrent Protective Devices.

B. Rate devices, bussing, supports, etc. equal to or greater than the short circuit current rating indicated. Provide fully-rated systems only. Series-rated systems are not acceptable, unless specifically noted otherwise.

PART 3 – EXECUTION

3.1 GENERAL:

A. Install panelboards 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.

3.2 IDENTIFICATION:

A. Provide 1/16" thick black plastic laminate labels with 1/4" high lettering on both the interior and exterior of each panelboard enclosure indicating name of panelboard. Bolt and nut or rivet labels to enclosure. (Sheet metal screws are not acceptable).

B. All subpanels shall be labeled to identify the main panel that supplies the feeder circuit.

3.3 MOUNTING:

A. Mount panelboards as indicated, but in no case higher than 6'-6" from finished floor to top of panel. Anchor enclosures firmly to walls and structural surfaces.

B. Provide 4" high concrete pad under floor-standing power distribution panelboards.

3.4 CIRCUIT DIRECTORIES:

A. For lighting and appliance panelboards, provide typed panelboard circuit directories. Indicate load description or name and location. Utilize actual building room numbers, not architectural room numbers used on drawings. Label the panel and circuit that feed this panel.

B. For power distribution panelboards, provide 1/16" thick black plastic laminate labels with 1/4" high lettering for each load served.

1. Provide red plastic laminate label for emergency loads.
2. If circuits are changed in a panel, type the new circuit designation and glue on existing circuit directory. Do not discard existing panelboard schedule unless all circuits have been changed.

3.5 WIRING METHODS:

A. Arrange conductors neatly within enclosure, and secure with suitable nylon ties.

B. Panelboards shall not be used for junction or splicing boxes or as a raceway.

3.6 ARRANGEMENT OF OVERCURRENT PROTECTIVE DEVICES:

A. The overcurrent protective devices shall be in the same sequence and labeled as the panel schedule on the drawings.

END OF SECTION 26 01 60

SECTION 26 01 70 – DISCONNECT SWITCHES

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. This section is a Division 26 General Provisions section, and is part of each Division 26, 27, and 28 sections making reference to disconnect switches.

1.2 DESCRIPTION OF WORK:

A. Extent of disconnect switch work is indicated by drawings and schedules and is specified herein.

B. Type of disconnects in this section include the following:

1. General Duty Disconnect Switches
2. Heavy Duty Disconnect Switches

1.3 QUALITY ASSURANCE:

A. STANDARDS: Refer to Section 260001 – Electrical General Provisions as applicable.

B. SUBMITTALS:

1. Product Data: Submit manufacturer's data on disconnect switches including specifications, installation instructions, etc.
2. Shop Drawings: Submit dimensioned drawings of disconnects showing accurately scaled layouts of disconnects and enclosures.
3. Equipment Room Layouts: Submit dimensioned drawings of all equipment rooms indicating spatial relationships to other proximate equipment. Insure that all code required clearances are maintained.

PART 2 – PRODUCTS

2.1 MANUFACTURERS:

A. Subject to compliance with all requirements, provide disconnect switches (fusible and non-fusible) and fusible switches (in power panels) from one of the following:

1. Cutler-Hammer
2. General Electric / ABB
3. Siemens
4. Square D

B. Subject to compliance with all requirements, provide bolted pressure switches from one of the following:

1. Bolt Switch
2. Cutler Hammer
3. General Electric / ABB
4. Pringle Switch
5. Siemens
6. Square D

2.2 GENERAL:

A. Provide fusible and/or non-fusible disconnect switches and ancillary components of types, sizes, ratings, and electrical characteristics as indicated. Provide enclosures in NEMA ratings suitable for applications. Provide fuses as indicated; See Section 260180 – Overcurrent Protective Devices.

2.3 GENERAL DUTY DISCONNECT SWITCHES:

A. Provide 240 volt rated, general duty switches in sheet steel enclosures as indicated of types, sizes, ratings, and electrical characteristics indicated and as required to suit respective application. Provide general duty switches for circuits rated 240 volts or less. Construct of spring-assisted, quick-make, quick-break mechanisms. Provide solid neutral as required by application. Equip with operating handle capable of being locked in the OFF position. Provide Class R rejection fuse clips for fusible-type switches.

2.4 HEAVY DUTY DISCONNECT SWITCHES:

A. Provide 600 volt rated, heavy duty switches in sheet steel enclosures as indicated of types, sizes, ratings, and electrical characteristics indicated and as required to suit respective application. Provide heavy duty switches for circuits rated greater than 240 volts, but less than 600 volts. Construct of spring-assisted, quick-make, quick-break mechanisms. Provide solid neutral as required by application. Equip with operating handle capable of being locked in the OFF position. Provide Class R rejection fuse clips for fusible-type switches.

PART 3 – EXECUTION

3.1 GENERAL:

A. Install disconnects 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.

3.2 IDENTIFICATION:

A. Provide 1/16" thick black plastic laminate labels with 1/4" high lettering on the exterior of each disconnect indicating name of disconnect or load served. Bolt labels to enclosure. Mark on interior cover the source of power by indicating the panel and circuit number.

3.3 MOUNTING:

A. Mount disconnects as indicated, but in no case higher than 6'-6" from finished floor to top of disconnect. Anchor enclosures firmly to walls and structural surfaces.

END OF SECTION 26 01 70

SECTION 26 01 80 - OVERCURRENT PROTECTIVE DEVICES

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. This section is a Division 26 General Provisions section, and is part of each Division 26, 27, and 28 section making reference to overcurrent protective devices.

1.2 DESCRIPTION OF WORK:

A. Extent of overcurrent protective devices is indicated by drawings and schedules and is specified herein.

B. Type of overcurrent protective devices in this section include the following:

1. Molded Case Circuit Breakers
2. Electronic Circuit Breakers
3. Fuses
4. Ground Fault Protection

1.3 QUALITY ASSURANCE:

A. STANDARDS: Refer to Section 260001 - Electrical General Provisions as applicable.

B. SUBMITTALS:

1. SHOP DRAWINGS: Submit manufacturer's data on overcurrent protective devices including specifications, time-current trip characteristics curves, mounting requirements, installation instructions, etc. Submit dimensioned drawings of overcurrent protective devices.
2. Equipment Room Layouts: Submit dimensioned drawings of all equipment rooms indicating spatial relationships to other proximate equipment. Insure that all code required clearances are maintained.

PART 2 – PRODUCTS

2.1 GENERAL:

A. Provide overcurrent protective devices and ancillary components of types, sizes, ratings, and electrical characteristics indicated. Provide enclosures in NEMA ratings as indicated and suitable for applications.

2.2 MOLDED CASE CIRCUIT BREAKERS:

A. MANUFACTURERS: Subject to compliance with all requirements, provide molded case circuit breakers from one of the following:

1. Cutler-Hammer
2. General Electric / ABB
3. Siemens
4. Square D

B. MOLDED CASE CIRCUIT BREAKERS:

1. Provide factory-assembled, molded case circuit breakers as integral components of lighting and appliance panelboards, power panelboards, switchboards, and for individual mounting as indicated. Provide thermal magnetic, molded case circuit breakers of amperages, voltages, types, and short circuit current ratings indicated. Provide bolt-on type breakers only. Construct with quick-break, quick-break mechanism with inverse-time delay and instantaneous trip protection for each pole. Provide breakers rated for ambient temperatures to suit respective applications. Provide mechanical screw type removable copper connector lugs of size to accommodate conductors specified.
2. Provide breakers that have interrupting ratings greater than or equal to the specified fault current. Provide fully-rated systems only. Series-rated systems are not acceptable, unless specifically noted otherwise.

2.3 ELECTRONIC CIRCUIT BREAKERS:

A. VENDORS: Subject to compliance with all requirements, provide electronic circuit breakers from one of the following:

1. Cutler-Hammer
2. General Electric / ABB
3. Siemens
4. Square D

B. **ELECTRONIC CIRCUIT BREAKERS:**

1. Provide factory-assembled, electric circuit breakers as integral components of power panelboards and switchboards. Unless noted otherwise on drawings, provide electronic circuit breakers in accordance with requirements as set forth in "MOLDED CASE CIRCUIT BREAKERS" above and with features as follows:
2. Provide electronic circuit breakers having the following selectable settings:
   a. Long time pickup and delay.
   b. Short time pickup and delay with I2T In and I2T Out features.
   c. Instantaneous.
   d. Ground fault pickup and delay with I2T In and I2T Out features.
3. Provide electronic circuit breakers having the following additional features:
   a. 100% rated.
   b. True RMS sensing.
   c. Interchangeable rating plugs.
   d. Thermal and magnetic backup protection.
   e. Long time and ground fault memory.
4. For any circuit breaker that is rated or can be adjusted to 1,200 amps or higher, provide an arc energy reduction maintenance switch that will allow the instantaneous trip setting to be adjusted less than the available arcing current. The switch shall be provided with settings that will allow for at least five (5) levels of reduction.

2.4 FUSES:

A. VENDORS: Subject to compliance with all requirements, provide fuses from one of the

following:

1. Bussmann
2. Gould Shawmut
3. Reliance
4. Littlefuse

B. FUSES: Provide fuses as integral components of disconnects, fusible switches, and bolted pressure switches. Provide fuses in types and sizes as recommended by manufacturer's written instructions. Provide fuses for mains, feeders, and branch circuits as follows:

1. Circuits 601 to 6000 amperes: Shall be protected by current limiting Bussmann Low-Peak Time-Delay Fuses KRP-C or equivalent. Fuses shall be UL Class L with an interrupting rating of 200,000 amperes r.m.s. symmetrical.
2. Motor and Transformer Circuits 0 to 600 amperes: Shall be protected by current-limiting Bussmann Low-Peak Dual Element Fuses LPN-RK (250 volts) or LPS-RK (600 volts) or equivalent. Fuses shall be UL Class RK1 with an interrupting rating of 200,000 amperes r.m.s. symmetrical.
3. Feeders to Circuit Breaker Panels 0 to 600 amperes: Shall be protected by current-limiting Bussmann Low-Peak Time Delay fuses LPJ or equivalent. Fuses shall be UL Class RK1 with an interrupting rating of 200,000 amperes r.m.s. symmetrical.

C. FUSE CABINETS:

2.5 GROUND FAULT PROTECTION:

A. VENDORS: Subject to compliance with all requirements, provide ground fault protection equipment from one of the following:

1. Cutler-Hammer
2. General Electric / ABB
3. Pringle Electric
4. Siemens
5. Square D

B. GROUND FAULT PROTECTION:

1. Provide ground fault protection systems to operate shunt trip or electric trip of thermal magnetic circuit breakers or bolted pressure switches and/or as integral components of electronic circuit breakers where indicated on drawings and as required to meet all the requirements as set forth in the NEC. Provide ground fault protection by means of a zero sequence ground fault sensor and ground fault relay. Provide power for ground fault relay through output of current sensor. Provide relay with current settings from 100 through 1200 amperes and time delay of .1 through 1 second. Provide cover that inhibits tampering with settings after installation. Provide means of testing the ground fault system without tripping the breaker or switch to meet the on-site testing requirements of the NEC. Provide visual trip indication for ground fault trip occurrences. Provide all interconnecting wiring as required.

PART 3 – EXECUTION

3.1 GENERAL:

A. Install overcurrent protective devices 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.

3.2 SIZING FUSES:

A. Size all fuses in accordance with manufacturer's written recommendations, whether fuse size is indicated on drawings or not. If nuisance tripping occurs, increase fuse size and disconnect if necessary as required to provide nuisance-free tripping. Adjust fuse size for proper ambient temperature, frequent starting and stopping of motor loads, and for loads with long start times.

3.3 IDENTIFICATION:

A. Provide 1/16" thick black plastic laminate labels with 1/4" high lettering on the exterior of each disconnect indicating name of disconnect or load served. Bolt labels to enclosure. Mark on interior cover the source of power by indicating the panel and circuit number.

3.4 MOUNTING:

A. Mount disconnects as indicated, but in no case higher than 6'-6" from finished floor to top of disconnect. Anchor enclosures firmly to walls and structural surfaces.

B. Provide 4" high concrete pad under floor-standing disconnects.

3.5 SETTINGS:

A. Adjust settings of overcurrent protective devices as directed by the Protective Device Study.

3.6 TESTING OF GROUND FAULT PROTECTION:

A. Have all ground fault protection systems tested by authorized factory representative for proper operation. Replace all malfunctioning units. A complete record of current trip level and time required to trip the disconnecting device shall be submitted to the owner.

3.7 SPARE PARTS:

A. Spare Fuses: For each type and ampere rating, furnish one spare fuse for every 5 provided, but not less than three total.

END OF SECTION 26 01 80

SECTION 26 01 82 – SWITCHBOARDS

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. This section is a Division 26 General Provisions section, and is part of each Division 26, 27, and 28 sections making reference to switchboards.

1.2 DESCRIPTION OF WORK:

A. Extent of switchboards is indicated by drawings and schedules and is specified herein.

1.3 QUALITY ASSURANCE:

A. STANDARDS: Refer to Section 260001 – Electrical General Provisions as applicable.

B. SUBMITTALS:

1. Shop Drawings: Submit dimensioned drawings of switchboards and enclosures showing accurately scaled layouts of enclosures. Include schedule of devices, including, but not necessarily limited to, circuit breakers, fusible switches, fuses, and accessories.
2. Equipment Room Layouts: Submit dimensioned drawings of all equipment rooms indicating spatial relationships to other proximate equipment. Insure that all code required clearances are maintained.

PART 2 – PRODUCTS

2.1 VENDORS:

A. Subject to compliance with all requirements, provide products from one of the follows:

1. Cutler-Hammer
2. General Electric / ABB
3. Siemens
4. Square D

2.2 GENERAL:

A. Provide switchboards, enclosures, and ancillary components, of types, sizes, and ratings indicated. Provide overcurrent protective devices, etc. as indicated on drawings for a complete installation. See Section 260180 – Overcurrent Protective Devices.

B. Rate devices, etc. equal to or greater than the short circuit current rating indicated. Provide fully-rated systems only. Series-rated systems are not acceptable, unless specifically noted otherwise.

2.3 AC DEAD-FRONT SWITCHBOARDS:

A. Provide factory assembled, front accessible, dead-front, floor-standing switchboards in NEMA types to suit respective applications. Construct bus bars of silver-plated copper braced to withstand RMS symmetrical fault current indicated. Provide ground bus in each section. Provide ANSI-61 painted finish.

B. Lugs shall be copper only.

PART 3 – EXECUTION

3.1 GENERAL:

A. Install switchboards 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.

3.2 IDENTIFICATION:

A. Provide 1/16" thick black plastic laminate labels with 1/4" high lettering on exterior of each enclosure indicating name of switchboard. Bolt labels to enclosure. Mark on enclosure the source of power by indicating the panel and circuit number.

3.3 MOUNTING:

A. Provide 4" high concrete pad. Mount switchboard as indicated, but in no case higher than 6'-6" from finished floor to top of switchboard including concrete pad. Bolt switchboard to concrete pad in accordance with Section 260072 – Electrical Support and Seismic Restraints.

3.4 CIRCUIT DIRECTORIES:

A. Provide 1/16" thick black plastic laminate labels with 1/4" high lettering for each load served.

3.5 WIRING METHODS:

A. Arrange conductors neatly within enclosure, and secure with suitable nylon ties.

END OF SECTION 26 01 82

SECTION 26 02 89 – SURGE PROTECTIVE DEVICES

PART 1 – GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. This Section includes Type 2 Surge Protective Devices for low-voltage power.

B. Related Sections include the following:

1. Division 26 Section "Switchboards" for factory-installed SPDs.
2. Division 26 Section "Panelboards" for factory-installed SPDs.

1.3 DEFINITIONS

A. ATS: Acceptance Testing Specifications.

B. VPR: Voltage Protection Rating.

C. SPD: Surge Protection Device.

1.4 SUBMITTALS

A. Product Data: For each type of product indicated. Include rated capacities, operating weights, operating characteristics, furnished specialties, and accessories.

B. Product Certificates: For surge protective devices, signed by product manufacturer certifying compliance with the following standards:

1. UL 1283.
2. UL 1449 3rd Edition.
3. UL 281-1 (fuse)
4. CSA 22.2.
5. NEMA LS-1

C. Manufacturer Seismic Qualification Certification: Submit certification that surge protective devices, accessories, and components will withstand seismic forces defined in Division 26 Section "Electrical Supports and Seismic Restraints." Include the following:

1. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.
   a. The term "withstand" means "the unit will remain in place without separation of any parts from the device when subjected to the seismic forces specified and the unit will be fully operational after the seismic event."
2. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.
3. Detailed description of equipment anchorage devices on which the certification is based

and their installation requirements.

D. Products Testing: For surge protective devices, provide the following product test data:

1. Provide actual let through voltage test data in the form of oscillograph results for the ANSA/IEEE C62.41 Category C3 & C1 (combination wave) and B3 (ringwave) tested in accordance with ANSI/IEEE C62.45.
2. Provide spectrum analysis of each unit based on MIL-STD-220A test procedures between 50 kHz and 200 kHz verifying the device noise attenuation equal or exceeds 50 db at 100 kHz.
3. Provide test report in compliance with NEMA LS1 from a recognized independent testing laboratory verifying that surge protection devicecomponents can survive published surge current rating on both a per mode and per phase basis using the IEEE C62.41, 8 x 20 microsecond current wave. Note that test data on individual module is not accepted.

E. Field quality-control test reports, including the following:

1. Test procedures used.
2. Test results that comply with requirements.
3. Failed test results and corrective action taken to achieve requirements.

F. Operation and Maintenance Data: For surge protective devices to include in emergency, operation, and maintenance manuals.

G. Warranties: Special warranties specified in this Section.

1.5 QUALITY ASSURANCE

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

B. Comply with ANSI/IEEE C62.41.1-2002, "IEEE Guide for Surge Environment in Low Voltage (1000 V and Less) AC Power Circuits," IEEE C62.41.2-2002, “IEEE Recommended Practice on Characterization of Surges in Low Voltage AC Power Circuits,” and test devices according to IEEE C62.45-2002, "IEEE Recommended Practice on Surge Testing for Equipment Connected to Low-Voltage AC Power Circuits."

C. Comply with NEMA LS 1, "Low Voltage Surge Protection Devices."

D. Comply with UL 1283, "Electromagnetic Interference Filters," and UL 1449 2nd Edition, "Surge Protective Devices."

E. The manufacturer shall be ISO 9000 certified.

F. Comply with Military Standards MIL-STD220A.

G. Comply with FIPS Pub 94.

H. Comply with NEC 2008, Article 285, “Surge Protective Devices.”

1.6 PROJECT CONDITIONS

A. Existing Utilities: Do not interrupt utilities serving facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary

utility services according to requirements indicated:

1. Notify Architect not less than two days in advance of proposed utility interruptions.
2. Do not proceed with utility interruptions without Architect's written permission.

B. Service Conditions: Rate surge protection devices for continuous operation under the following conditions, unless otherwise indicated:

1. Maximum Continuous Operating Voltage: Not less than 115 percent of nominal system operating voltage.
2. Operating Temperature: -40 to 140 deg F.
3. Humidity: 5 to 95 percent, non-condensing.
4. Altitude: Up to 20,000 feet above sea level.

1.7 COORDINATION

A. Coordinate location of field-mounted surge protection devices to allow adequate clearances for maintenance. Coordinate placement of breakers in electrical panelboards feeding field-mounted surge protection devices so that conductor leads are kept to an absolute minimum.

B. Coordinate surge protection devices with Division 26 Section "Electrical Power Monitoring and Control."

1.8 WARRANTY

A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of surge protection devices that fail in materials or workmanship within five years from date of Substantial Completion.

PART 2 – PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. ASCO Power Technologies
2. Current Technology, Inc.
3. Cutler-Hammer, Inc.; Eaton Corporation.
4. EFI Electronics
5. General Electric Company.
6. LEA International.
7. Leviton Mfg. Company Inc.
8. Liebert Corporation; a division of Emerson.
9. Siemens Energy & Automation, Inc.
10. Square D; Schneider Electric.
11. United Power Corporation.

2.2 VOLTAGE SURGE SUPPRESSION – GENERAL

A. Electrical Requirements:

1. Unit Operating Voltage – Refer to drawings for operating voltage and unit configuration.

2. Maximum Continuous Operating Voltage (MCOV) – The MCOV shall be greater than 115% of the nominal system operating voltage.
3. The suppression system shall incorporate a hybrid designed Metal-Oxide Varistors (MOV) surge protection device for the service entrance and other distribution level. The system shall not utilize silicon avalanche diodes, selenium cell, air gaps or other components that may crowbar the system voltage leading to system upset or create any environmental hazards.
4. Protection Modes – For a wye-configured system, the device must have directly connected suppression elements between line-neutral (L-N), line-ground (L-G), and neutral-ground (N-G). For a delta-configured system, the device must have suppression elements between line to line (L-L) and line to ground (L-G).
5. UL 1449 3rd Edition Voltage Protection Rating (VPR) – The maximum UL 1449 3rd Edition VPR for the device must not exceed the following:
   a. 208Y/120 V:
      1) L-N; L-G; N-G: 700 V.
      2) L-L: 1200 V.
   b. 480Y/277 V:
      1) L-N; L-G; N-G: 1200 V.
      2) L-L: 2000 V.
6. ANSI/IEEE Cat. C3 Let Through Voltage – The let through voltage based on IEEE C62.41 and C62.45 recommended procedures for Category C3 surges (20 kV, 10 kA) shall be less than:
   a. 208Y/120 V L-N: 560 V.
   b. 480Y/277 V L-N: 960 V.
7. ANSI/IEEE Cat. B3 Let Through Voltage – Let through voltage based on IEEE C62.41 and C62.45 recommended procedures for the ANSI/IEEE Cat. B3 ringwave (6 kV, 500 amps) shall be less than:
   a. 208Y/120 V L-N: 160 V.
   b. 480Y/277 V L-N: 165 V.

B. SPD Design

1. Balanced Suppression Platform – The surge current shall be equally distributed to all MOV components to ensure equal stressing and maximum performance. The surge suppression platform must provide equal impedance paths to each matched MOV. Designs incorporating SPD modules shall not be acceptable.
2. Electrical Noise Filter – Each unit shall include a high-performance EMI/RFI noise rejection filter. Noise attenuation for electric line noise shall be 50 dB at 100 kHz using the MIL-STD-220A insertion loss test method. Products not able to demonstrate noise attenuation of 50 dB @ 100 kHz shall be rejected.
3. Extended Range Filter – The Surge Protective Device shall have a High Frequency Extended Range Tracking Filter in each Line to Neutral mode with compliance to UL 1283 and NEMA LS1. The filter shall have published high frequency attenuation rating in the attenuation frequencies:
   a. Insertion Loss (ratio):
      1) 50kHz: 40
      2) 100kHz: 316
      3) 500kHz: 316
      4) 1MHz: 89
      5) 10MHz: 200
      6) 100MHz: 79
   b. Insertion Loss (dB):
      1) 50kHz: 32
      2) 100kHz: 50
      3) 500kHz: 50
      4) 1MHz: 39

5) 10MHz: 46
6) 100MHz: 38

4. Internal Connections – No plug-in component modules or printed circuit boards shall be used as surge current conductors. All internal components shall be hardwired with connections utilizing low impedance conductors and compression fittings.
5. Standard Monitoring Diagnostics – Each SPD shall provide integral monitoring options:
   a. Each unit shall provide a green / red solid state indicator light shall be provided on each phase. The absence of a green light and the presence of a red light shall indicate which phase(s) have been damaged.
   b. Contacts for Remote Status Monitoring – The SPD device must include form C dry contacts (one NO and one NC) for remote annunciation of unit status. The remote alarm shall change state if any of the three phases detect a fault condition.
6. Monitoring Diagnostics:
   a. Audible Alarm – The SPD shall provide an audible alarm with a reset pushbutton that will be activated under any fault condition.
   b. Event Counter – The SPD shall be equipped with a LCD display system designed to indicate to the user how many surges, sags, swells and outages have occurred at the location. The event counter triggers each time under each respective category after significant even occurs. A reset pushbutton shall also be standard allowing all counters to be zeroed.
   c. Push to Test – The SPD shall be equipped with push-to-test feature, designed to provide users with real time testing of the surge protection device's monitoring and diagnostic system. By depressing the test button, the diagnostic system initiates a self test procedure. If the system is fully operational, the self test will activate all indicator lights.
7. Overcurrent Protection Fusing: In order to isolate the SPD under any fault condition, the manufacturer shall provide:
   a. Individual Fusing: MOVs shall be individually fused via Copper Fuse Trace. The Copper Fuse shall allow protection during high surge (kA) events. SPD shall safely reach an end-of-life condition when subjected to fault current levels between 0 and 200 kA, including low level fault currents from 5 to 5000 amperes.
   b. Thermal Protection: MOVs shall be equipped with Thermal Fuse Spring (TFS) technology which allows disconnection of the suppression component at the overheated stage common during temporary over voltage condition. For small fault currents between 100mA to 30Amp, or if the occurrence is over a longer period of time, the TFS will disconnect first. Manufacturers that utilize fuse trace only shall not be approved since there is no fault current protection between 100mA to 30A,
   c. All overcurrent protection components shall be tested in compliance with UL 1449-Limited Current Test and AIC rating test.

C. Minimum Repetitive Surge Current Capability as per ANSI/IEEE C62.41 and ANSI/IEEE C62.45 – 2002:

1. The suppression filter system shall be repetitive surge tested in every mode utilizing a 1.2 x 50 microseconds, 20kV open circuit voltage. 8 x 20 microsecond, 10kA short circuit current Category C3 bi-wave at one minute intervals without suffering either performance degradation or more than 10% deviation of clamping voltage at a specified surge current. The minimum repetitive surge current capability as per ANSI/IEEE C62.41 and ANSI/IEEE C62.45 – 1992 shall be:
   a. Service Entrance: 5000 impulse per mode.
   b. Distribution Locations: 5000 impulse per mode.
   c. Branch Locations: 5000 impulse per mode.

2.3 SYSTEM APPLICATION

A. Locations – Electrical drawings indicate the location and IEEE Category requirements of all required SPD's.

B. Surge Current Capacity – The minimum total surge current 8 x 20 microsecond waveform that the device is capable of withstanding shall be as follows:

1. IEEE Category "C" Locations:
   a. Per Phase: 250kA.
   b. Per Mode: 125kA.
2. IEEE Category "B" Locations:
   a. Per Phase: 160kA.
   b. Per Mode: 80kA.
3. IEEE Category "A" Locations:
   a. Per Phase: 120kA.
   b. Per Mode: 60kA.

C. Lighting and Appliance Panelboard Requirements:

1. Factory-Installed SPD:
   a. The SPD shall not limit the use of Through-feed lugs, Sub-feed lugs and Sub-feed breaker options.
   b. The SPD shall be immediately installed on the load side of the main breaker or main lugs.
   c. The panelboard shall be capable of re-energizing upon removal of the SPD.
   d. A direct bus bar connection shall be used to mount the SPD component to the panelboard bus bar to reduce the impedance of the shunt path.
   e. The SPD panelboard shall be constructed using a direct bus bar connection (cable connection between bus bar and SPD device in not acceptable). SPD units that use a cable connection do not meet the intent of this specification. For this option, the breaker shown on the electrical drawings shall be deleted.
   f. The SPD shall be included and mounted within the panelboard by the manufacturer of the panelboard.
   g. The SPD shall be of the same manufacturer as the panelboard.
   h. The complete panelboard including the SPD shall be UL67 listed.

D. Power Distribution Panelboard and Switchboard Requirements – Any one of the following options are acceptable:

1. Factory-Installed SPD:
   a. The SPD shall be of the same manufacturer as the power distribution panelboard, motor control center, or switchboard.
   b. The SPD shall be factory installed inside the power distribution panelboard, motor control center, or switchboard at the assembly point by the original equipment manufacturer.
   c. Locate surge protection device on load side of main disconnect device or main lugs, as close as possible to the phase conductors and ground/neutral bar.
   d. Provide a disconnect sized in accordance with all manufacturer's recommendations. The disconnect shall be directly integrated to the surge protection device and assembly bus by using bolted bus bar connections. The disconnect is the preferred method. If otherwise recommended by the manufacturer, provide a multi-pole circuit breaker in the panelboard in size as recommended by the manufacturer to feed the surge protection device. The size of the breaker shall supersede the size of the breaker shown on the electrical drawings. Provide copper conductors in size as recommended by the manufacturer for connecting the phases, neutral, and ground between the surge protection device and the circuit breaker in the panelboard. The size of the

conductor shall supersede the size of the conductors shown on the electrical drawings.

e. The SPD shall be integral to power distribution panelboard, motor control center, or switchboard as factory standardized design.

f. All monitoring diagnostics features shall be visible from the front of the equipment.

2.4 ENCLOSURES

A. Provide enclosures suitable for locations as indicated on the drawings or as described below:

1. NEMA 1/3R rainproof enclosures intended for outdoor use primarily to provide protection against rain, sleet and damage from external ice formation.
2. NEMA 12 dust-tight enclosures intended for indoor use primarily to provide protection against circulating dust, falling dirt and dripping non-corrosive liquids. (Panelboards Only)
3. NEMA 4 watertight stainless steel intended for indoor or outdoor use primarily to provide protection against windblown dust and rain, splashing rain, hose-directed water, and damage from external ice formation. (Side Mounted Unites Only)

PART 3 – EXECUTION

3.1 INSTALLATION OF SURGE PROTECTION DEVICES

A. Install devices at service entrance on load side, with ground lead bonded to service entrance ground.

B. Install devices for panelboard and auxiliary panels with conductors or buses between surge protection device and points of attachment as short and straight as possible. Do not exceed manufacturer's recommended lead length. Do not bond neutral and ground at SPD.

3.2 PLACING SYSTEM INTO SERVICE

A. Do not energize or connect electrical equipment to their sources until surge protection devices are installed and connected.

3.3 FIELD QUALITY CONTROL

A. Testing: Perform the following field tests and inspections and prepare test reports:

1. After installing surge protection devices, but before electrical circuitry has been energized, test for compliance with requirements.
2. Complete startup checks according to manufacturer's written instructions.
3. Perform each visual and mechanical inspection and electrical test stated in NETA ATS, "Surge Arresters, Low-Voltage Surge Protection Devices" Section. Certify compliance with test parameters.

B. Remove and replace malfunctioning units and retest as specified above.

3.4 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to

adjust, operate, and maintain surge protective devices. Refer to Division 1 Section "Closeout Procedures" or "Demonstration and Training" as may be applicable.

END OF SECTION 26 02 89

SECTION 26 04 20 – SERVICE ENTRANCE

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. This section is a Division 26 General Provisions section, and is part of each Division 26, 27, and 28 sections making reference to service entrances.

1.2 DESCRIPTION OF WORK:

A. Extent of service entrance work is indicated by drawings and schedules and is specified herein.

B. Work under this section includes the following:

1. Power Company Coordination and Fees
2. Power Company Transformer Pads
3. Raceways and Conductors
4. CT Enclosures
5. Service Entrance Switchboards and/or Panelboards
6. Overcurrent Protective Devices and/or disconnects

1.3 QUALITY ASSURANCE:

A. STANDARDS: Refer to Section 260001 – Electrical General Provisions as applicable.

B. SUBMITTALS:

1. Shop Drawings: Submit manufacturer's data on service entrance equipment and accessories. Submit dimensioned drawings of service entrance equipment.
2. Equipment Room Layouts: Submit dimensioned drawings of all equipment rooms containing service entrance equipment indicating spatial relationships to other proximate equipment. Insure that all code required clearances are maintained.

PART 2 – PRODUCTS

2.1 GENERAL:

A. Provide service entrance equipment and accessories of types, sizes, ratings, and electrical characteristics indicated or as otherwise required to provide a complete system. See other applicable sections.

2.2 POWER COMPANY COORDINATION AND FEES:

A. Coordinate and comply with all power company requirements. Verify all costs for line extensions (both high voltage and low voltage conductors), underground service fees, etc. with Power Company prior to bid. Include all costs in bid. Confirm location of point of service before

bidding.

2.3 POWER COMPANY TRANSFORMER PADS AND VAULTS:

A. Provide steel reinforced, concrete transformer pads and/or vaults of sizes and with openings in accordance with the latest standards and requirements of the local power company. Verify all requirements with Power Company prior to installation.

2.4 RACEWAYS AND CONDUCTORS:

A. Provide service entrance raceways and conductors in accordance with Section 260110 – Conduit Raceways, and Section 260120 – Conductors and Cables.

2.5 CT ENCLOSURES:

A. Provide CT enclosures complete with meter bases of types and sizes in accordance with all power company requirements. Provide steel reinforced, concrete pads with openings in accordance with same. Refer to "Concrete Bases" under Section 260001 – Electrical General Provisions. Verify and comply with all power company requirements prior to installation.

2.6 SERVICE ENTRANCE SWITCHBOARDS AND/OR PANELBOARDS:

A. Provide service entrance switchboards and/or panelboards in accordance with Section 260182 – Switchboards, and Section 260160 – Panelboards. Rate all service switchboards and/or panelboards as service entrance equipment.

2.7 OVERCURRENT PROTECTIVE DEVICES AND/OR DISCONNECTS:

A. Provide overcurrent protective devices and/or disconnects in service switchboards and/or panelboards in accordance with Section 260180 – Overcurrent Protective Devices, and Section 260170 – Disconnect Switches.

PART 3 – EXECUTION

3.1 GENERAL:

A. Install service entrance equipment and accessories 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.

3.2 TRANSFORMER LOCATIONS:

A. Verify and coordinate exact placement of concrete pad with local power company prior to installation. Strictly maintain sufficient distances from door, window, building walls and overhangs, gas meters, fuel tanks, etc. in accordance with all power company requirements. Field-verify placement of transformer pad in company with the local power company representative.

3.3 COORDINATION:

A. Coordinate all service entrance work with other trades.

B. Power Company Coordination: Coordinate installation of service entrance equipment with Power Company and insure that power to building is ready when needed. After the contract has been signed, immediately notify the engineer that the project is underway and indicated when power to the building/project is needed. It is the engineer's responsibility to complete and submit the power company service request form.

END OF SECTION 26 04 20

SECTION 26 04 35 – PROTECTIVE DEVICE STUDY

PART 1 – GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification sections, apply to this section.

1.2 SUMMARY

A. 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.

1.3 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.

1.4 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.

1.5 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. CGI CYME.
2. EDSA Micro Corporation.
3. ESA Inc.
4. Operation Technology, Inc.

5. 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] [IEEE 241] 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-**[and high-]**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] [IEEE 241] [IEEE 242] 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 overcurrrent 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 mother 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 computer 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 included 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, on 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 26 04 35

SECTION 26 04 52 – GROUNDING

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. This section is a Division 26 General Provisions section, and is part of each Division 26, 27, and 28 sections making reference to grounding.

1.2 DESCRIPTION OF WORK:

A. Extent of grounding work is indicated by drawings and schedules and is specified herein.

B. Ground the complete electrical installation including the system neutral, metallic conduits and raceways, boxes, fittings, devices, cabinets, equipment, and separately derived systems in accordance with the NEC and all other applicable codes to provide a permanent, continuous, low impedance, grounding system.

C. Provide grounding system such that the resistance from the service entrance ground bus, through the grounding electrode to earth is not greater than 5 ohms.

1.3 QUALITY ASSURANCE:

A. STANDARDS: Refer to Section 260001 – Electrical General Provisions as applicable.

B. TESTING: Submit results of ground resistance testing as specified in this section. Include name of testing agency with report. Include test results in operation and maintenance manuals.

PART 2 – PRODUCTS

2.1 GENERAL:

A. Provide grounding equipment and accessories of types, sizes, ratings, and electrical characteristics indicated or as otherwise required to provide a complete system.

2.2 GROUNDING CONDUCTORS:

A. Unless noted otherwise, provide grounding conductors with stranding and insulation types to match phase conductors. Provide conductors with green insulation if possible; otherwise wrap with green tape. Size ground conductors as indicated on drawings. Do not size ground conductors smaller than that allowable by NEC.

2.3 GROUND RODS:

A. Provide copper clad, steel, 3/4" diameter by 10' long, ground rods (Weaver, Cadweld, or equivalent).

2.4 TEST WELLS:

A. Provide precast concrete box 9-1/2" W. x 16" L. x 18" D. with light duty concrete cover for non-traffic areas or rated steel plate for traffic areas. Provide covers with lifting holes. Engrave cover with "Ground Rod".

2.5 CONCRETE ENCASED GROUNDING ELECTRODE (UFER GROUND):

A. Provide a bare copper conductor encased along the bottom of concrete foundation or footing that is in direct contact with the earth and where there is no impervious water-proofing membrane between the footing and the soil. Size UFER ground conductor in accordance with the NEC. Extend conductor through a horizontal length of 30' minimum and encase with not less than 2 nor more than 5 inches of concrete separating it from surrounding soils.

2.6 INSULATED GROUNDING BUSHINGS:

A. Provide plated malleable iron body with 150 degree Centigrade molded plastic insulating throat, lay-in grounding lug with hardened stainless steel fasteners (OZ Gedney BLG or equivalent).

2.7 CONNECTION TO PIPES:

A. Provide heavy duty, cast bronze, ground clamp systems with silicon bronze bolts and nuts (OZ Gedney G Series - B or equivalent).

2.8 CONNECTIONS TO STRUCTURAL STEEL, GROUND RODS, OR SPLICES:

A. Provide exothermic welds. (Cadweld or equivalent)

2.9 BONDING JUMPERS:

A. Provide bonding jumpers with hot dip galvanized malleable or ductile iron clamps, hot dip galvanized steel U-bolts, and tinned copper braids (OZ Gedney BJ Series or equivalent).

2.10 GROUND BUS:

A. Provide 1/4" x 4", copper ground bus complete with insulators and brackets in lengths and at mounting heights as indicated on drawings. Furnish complete with drilled holes and lugs to accommodate grounding conductors.

PART 3 – EXECUTION

3.1 GENERAL:

A. Install grounding systems 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.

3.2 CLEANING:

A. Thoroughly clean all metal contact surfaces prior to installation of clamp-on connectors.

3.3 SEPARATELY DERIVED SYSTEMS:

A. Ground each separately derived system in accordance with NEC Section 250-16 unless otherwise indicated on drawings.

3.4 SERVICE ENTRANCE GROUNDING:

A. Connect the following items using NEC sized copper grounding conductors (in NEC sized, conduits if concealment is required) to lugs on the service ground bus:

1. Conductor from the UFER ground.
2. Conductor from two ground rods driven exterior to building at not less than 10' apart.
3. Conductor from main incoming cold water piping system.
4. Conductor from building structural steel.
5. Conductor from separately derived systems.
6. Conductor from insulated ground bushings on service entrance conduits.
7. Additional ground rods as required to achieve resistance value specified.
8. Additional items indicated on drawings.

3.5 EQUIPMENT BONDING AND GROUNDING:

A. Provide an NEC sized conductor, whether indicated or not on the drawings, in raceways as follows:

1. Non-metallic conduits and ducts.
2. Distribution feeders.
3. Motor and equipment branch circuits.
4. Device and lighting branch circuits.
5. Full length of all multi-outlet assemblies and other surface wireways.

3.6 ADDITIONAL GROUNDING INSTALLATION REQUIREMENTS:

A. Provide grounding bushings on all service conduit and conduits installed in concentric/eccentric knock-outs or reducing washer at panelboards, cabinets, and gutters.

B. Provide bonding jumpers across expansion and deflection couplings in conduit runs, across pipe connections at water meters, and across dielectric couplings in metallic cold water piping system. Connection to water piping system shall be made electrically continuous by connecting to the street side of the water main valve and/or installing additional bonding jumpers across the meter, valves or service unions that might be disconnected.

C. Provide bonding wire in all flexible conduits.

D. Isolated Ground Circuits: Circuits used for isolated ground outlets shall be run in separate raceways or shall have a separate green insulated ground conductor installed and tagged for identification at all outlet and junction boxes.

3.7 TEST WELLS:

A. All ground rods shall be driven external to building and shall be located in ground well boxes. Locate in landscaped areas where possible.

3.8 TESTING:

A. Obtain and record ground resistance measurements both from service entrance ground bus to the ground electrode and from the ground electrode to earth. Install additional bonding and grounding electrodes as required to comply with resistance limits specified under this Section.

Use independent testing agency for all testing.

END OF SECTION 26 04 52

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SECTION 26 05 60 – NETWORK LIGHTING CONTROL SYSTEM

PART 1 – GENERAL

1.1. RELATED DOCUMENTS

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

1.2. SUMMARY

A. The lighting control system specified in this section shall provide time-based, sensor-based (both occupancy and daylight), and manual lighting control.
B. The system shall be capable of turning lighting loads on/off as well as dimming lights (if lighting load is capable of being dimmed)
C. System devices indicated shall be networked together enabling digital communication and shall be individually addressable.
D. The system architecture shall be capable of enabling stand-alone groups (rooms) of devices to function in some default capacity even if network connectivity to the greater system is lost.
E. The system architecture shall facilitate remote operation via a computer connection.
F. The system shall not require any centrally hardwired switching equipment.
G. The system shall be capable of wireless, wired, or hybrid wireless/wired architectures.

1.3. DEFINITIONS

A. NA

1.4. SUBMITTALS

A. Product Datasheets (general device descriptions, dimensions, wiring details, nomenclature)
B. Riser Diagrams – typical per room type (detailed drawings showing device interconnectivity of devices)
C. Other Diagrams – as needed for special operation or interaction with other system(s)
D. Example Contractor Startup/Commissioning Worksheet – must be completed prior to factory start-up
E. Hardware and Software Operation Manuals
F. Other operational descriptions as needed

1.5. QUALITY ASSURANCE

A. All steps in sensor manufacturing process shall occur in the USA; including population of all electronic components on circuit boards, soldering, programming, wiring, and housing.

B. All components and the manufacturing facility where product was manufactured must be ROHS compliant.

C. In high humidity or cold environments, the sensors shall be conformably coated and rated for condensing humidity and -40 degree Fahrenheit (and Celsius) operation.

D. All applicable products must be UL / CUL Listed or other acceptable national testing organization.

1.6. COORDINATION

A. Coordinate lighting control components to form an integrated interconnection of compatible components.

B. Coordinate lighting controls with BAS (if necessary) either through IP based intercommunication of system or hardwired auxiliary relay outputs.

C. The installing contractor shall be responsible for a complete and functional system in accordance with all applicable local and national codes.

1.7. WARRANTY

A. All devices in lighting control system shall have a 5 year warranty.

1.8. SPARE PARTS

A. Provide a minimum of 5%, but not less than three (3) of each type of devices as follows:

1. Low voltage lighting control wall switches – each type utilized.
2. Daylight sensors.
3. Occupancy sensors.
4. Power (relay) packs.
5. Auxiliary input/output (I/O) Devices.

PART 2 – PRODUCTS

2.1. MANUFACTURERS

A. Basis of Design: This specification is based on the nLight® Network Control System

B. Subject to compliance with all requirements, Digital Lighting Management System from Wattstopper

C. Subject to compliance with all requirements, Lutron Quantum Total Light Management (wired)

D. Subject to compliance with all requirements, Cooper Wavelinx

2.2. SYSTEM REQUIREMENTS

A. System shall have an architecture that is based upon three main concepts; 1) intelligent lighting control devices 2) standalone lighting control zones 3) network backbone for remote or time based operation.

B. Intelligent lighting control devices shall consist of one or more basic lighting control components; occupancy sensors, photocell sensors, relays, dimming outputs, manual switch stations, and manual dimming stations. Combining one or more of these components into a single device enclosure should be permissible so as to minimize overall device count of system.

C. System must interface directly with intelligent LED luminaires such that only CAT-5 cabling is required to interconnect luminaires with control components such as sensors and switches (see *Networked LED Luminaire* section)

D. Intelligent lighting control devices shall communicate digitally, require <4 mA of current to function (Graphic wall stations excluded), and posses RJ-45 style connectors.

E. Lighting control zones shall consist of one or more intelligent lighting control components, be capable of stand-alone operation, and be capable of being connected to a higher level network backbone.

F. Devices within a lighting control zone shall be connected with CAT-5e low voltage cabling in any order.

G. Lighting control zone shall be capable of automatically configuring itself for default operation without any start-up labor required.

H. Individual lighting zones must continue to provide a user defined default level of lighting control in the event of a system communication failure with the backbone network or the management software becoming unavailable.

I. Power for devices within a lighting control zone shall come from either resident devices already present for switching (relay device) or dimming purposes, or from the network backbone. Standalone “bus power supplies” shall not be required in all cases.

J. All switching and dimming for a specific lighting zone shall take place within the devices located in the zone itself (i.e. not in a remotely located devices such as panels) to facilitate system robustness and minimize wiring requirements. Specific applications that require centralized or remote switching shall be capable of being accommodated.

K. System shall have one or more primary wall mounted network control “gateway” devices that are capable of accessing and controlling connected system devices and linking into an Ethernet LAN.

L. System shall use “bridge” devices that route communication and distribute power for up to 8 directly connected lighting zones together for purposes of decreasing system wiring requirements.

M. System shall be capable of wirelessly connecting a lighting zone to a WiFi (802.11n) wireless data network for purposes of eliminating the “bridge” devices and all cabling that connects zones to bridge devices.

N. WiFi enabled devices shall be able to detect when WiFi network is down and revert to a user directed default state.

O. WiFi-enabled devices shall be capable of current monitoring

P. WiFi-enabled devices shall utilize WPA2 AES encryption

Q. WiFi-enabled devices shall be able to connect to 802.11b/g/n WiFi networks

R. WiFi-enabled devices shall have at least one local RJ-45 port for communicating with nonWiFi-enabled system devices

S. System shall have a web-based software management program that enables remote system control, status monitoring, and creation of lighting control profiles.

T. Individual lighting zones shall be capable of being segmented into several “local” channels of occupancy, photocell, and switch functionality for more advanced configurations and sequences of operation.

U. Devices located in different lighting zones shall be able to communicate occupancy, photocell, and switch information via either the wired or WiFi backbone.

V. System shall be capable of operating a lighting control zone according to several sequences of operation. System shall be able to change a spaces sequence of operation according to a time schedule so as to enable customized time-of-day, day-of-week utilization of a space. Note operating modes should be utilized only in manners consistent with local energy codes.

a. Auto-On / Auto-Off (via occupancy sensors)
   - Zones with occupancy sensors automatically turn lights on when occupant is detected.
   - Zones with occupancy and/or photocell sensors turn lights off when vacancy or sufficient daylight is detected.
   - Pressing a switch will turn lights off. The lights will remain off regardless of occupancy until switch is pressed again, restoring the sensor to Automatic On functionality.

b. Manual-On / Auto-Off (also called Semi-Automatic)

- Pushing a switch will turn lights on.
- Zones with occupancy and/or photocell sensors turn lights off when vacancy or sufficient daylight is detected.

c. Manual-On to Auto-On/Auto-Off
- Pushing a switch will turn lights on.
- After initial lights on, zones with occupancy and/or photocell sensors turn lights on/off according to occupancy/vacancy and/or daylight conditions.
- Sequence can be reset via scheduled (ex. daily each morning) events

d. Auto-to-Override On
- Zones with occupancy sensors automatically turn lights on when occupant is detected.
- Zone lighting then goes into an override on state for a set amount of time or until the next time event returns the lighting to an auto-off style of control.
- Sequence can be reset via scheduled (ex. daily each morning) events

e. Manual-to-Override On
- Pushing a switch will turn lights on.
- Zone lighting then goes into an override on state for a set amount of time or until the next time event returns the lighting to an auto-off style of control.
- Sequence can be reset via scheduled (ex. daily each morning) events

f. Auto On / Predictive Off
- Zones with occupancy sensors automatically turn lights on when occupant is detected.
- Zones with occupancy and/or photocell sensors turn lights off when vacancy or sufficient daylight is detected.
- If switch is pressed, lights turn off and a short “exit timer” begins. After timer expires, sensor scans the room to detect whether occupant is still present. If no occupancy is detected, zone returns to auto-on. If occupancy is detected, lights must be turned on via the switch.

g. Multi-Level Operation (multiple lighting levels per manual button press)
- Operating mode designed specifically for bi-level applications
- Enables the user to cycle through the up to four potential on/off lighting states using only a single button.
- Eliminates user confusion as to which of two buttons controls which load
- Three different transition sequences are available in order to comply with energy codes or user preference)
- Mode available as a setting on all nLight devices that have single manual on/off switch (ex. nWSX, nPODM, nPODM-DX).
- Depending on the sequence selected, every button push steps through relays states according to below table
- In addition to achieving bi-level lighting control by switching loads with relays, the ability to command dimming outputs to “step” in a sequence that achieves bi-level operation is present.

	Alternating Sequence		**Full On Sequence**		**3 Step On Sequence**	
Sequence State #	Relay 1	Relay 2	Relay 1	Relay 2	Relay 1	Relay 2
1	On	Off	On	Off	On	Off
2	Off	On	-	-	Off	On

3	-	-	On	On	On	On
4*	Off	Off	Off	Off	Off	Off

(*step only present for devices without separate off button)

W. A taskbar style desktop application shall be available for personal lighting control.

X. An application that runs on “smart” handheld devices (such as an Apple® IPhone®) shall be available for personal lighting control.

Y. Control software shall enable logging of system performance data and presenting useful information in a web-based graphical format and downloadable to .CSV files.

Z. Control software shall enable integration with a BMS via BACnet IP.

AA. System shall provide the option of having pre-terminated plenum rated CAT-5 cabling supplied with hardware.

2.3. INDIVIDUAL DEVICE SPECIFICATIONS

A. Control Module (Gateway)

a. Control module shall be a device that facilitates communication and time-based control of downstream network devices and linking into an Ethernet.
b. Devices shall have a user interface that is capable of wall mounting, powered by low voltage, and have a touch screen.
c. Control device shall have three RJ-45 ports for connection to other backbone devices (bridges) or directly to lighting control devices.
d. Device shall automatically detect all devices downstream of it.
e. Device shall have a standard and astronomical internal time clock.
f. Device shall have one RJ-45 10/100 BaseT Ethernet connection.
g. Device shall have a USB port
h. Each control gateway device shall be capable of linking 1500 devices to the management software.
i. Device shall be capable of using a dedicated or DHCP assigned IP address.
j. Network Control Gateway device shall be the following Sensor Switch model Series:

nGWY2

B. Networked System Occupancy Sensors

a. Occupancy sensors system shall sense the presence of human activity within the desired space and fully control the on/off function of the lights.

b. Sensors shall utilize passive infrared (PIR) technology, which detects occupant motion, to initially turn lights on from an off state; thus preventing false on conditions. Ultrasonic or Microwave based sensing technologies shall not be accepted.

c. For applications where a second method of sensing is necessary to adequately detect maintained occupancy (such as in rooms with obstructions), a sensor with an additional “dual” technology shall be used.

d. Dual technology sensors shall have one of its two technologies not require motion to detect occupancy. Acceptable dual technology includes PIR/Microphonics (also known as Passive Dual Technology or PDT) which both looks for occupant motion and listens for sounds indicating occupants. Sensors where both technologies detect motion (PIR/Ultrasonic) shall not be acceptable.

e. All sensing technologies shall be acoustically passive meaning they do not transmit sounds waves of any frequency (for example in the Ultrasonic range), as these technologies have the potential for interference with other electronic devices within the space (such as electronic white board readers). Acceptable detection technologies include Passive Infrared (PIR), and/or Microphonics technology. Ultrasonic or Microwave based sensing technologies shall not be accepted.

f. Sensors shall be available with zero, one, or two integrated Class 1 switching relays, and up to one 0-10 VDC dimming output. Sensors shall be capable of switching 120 / 277 / 347 VAC. Load ratings shall be 800 W @ 120 VAC, 1200 W @ 277 VAC, 1500 W @ 347 VAC, and ¼ HP motor. Relays shall be dry contacts.

g. Sensors shall be available with one or two occupancy "poles", each of which provides a programmable time delay.

h. Sensors shall be available in multiple lens options which are customized for specific applications.

i. Communication and Class 2 low voltage power shall be delivered to each device via standard CAT-5 low voltage cabling with RJ-45 connectors.

j. All sensors shall have two RJ-45 ports or capable of utilizing a splitter.

k. All sensors shall have the ability to detect when it is not receiving valid communication (via CAT-5 connections) and blink its LED in a pattern to visually indicate of a potential wiring issue

l. Every sensor parameter shall be available and configurable remotely from the software and locally via the device push-button.

m. Sensors shall be able to function together with other sensors in order to provide expanded coverage areas by simply daisy-chain wiring together the units with CAT-5 cabling.

n. Sensors shall be equipped with an automatic override for 100 hour burn-in of lamps. This feature must be available at any time for lamp replacements.

o. Wall switch sensors shall recess into single-gang switch box and fit a standard GFI opening.

p. Wall switch sensors must meet NEC grounding requirements by providing a dedicated ground connection and grounding to mounting strap. Line and load wire connections shall be interchangeable. Sensor shall not allow current to pass to the load when sensor is in the unoccupied (Off) condition.

q. Wall switch sensors shall have optional features for photocell/daylight override, vandal resistant lens, and low temperature/high humidity operation.

r. Wall switch sensors shall be available in four standard colors (Ivory, White, Light Almond, Gray)

s. Wall switch sensors shall be available with optional raise/lower dimming adjustment controls

t. Wall switch sensors shall be the following Sensor Switch model numbers, with device color and optional features as specified:

nWSD or nWSX (PIR, 1 Relay)

nWSD PDT or nWSX PDT (Dual Tech, 1 Relay)

nWSD NL (PIR w/ Night Light, 1 Relay)

nWSD PDT NL (Dual Tech w/ Night Light, 1 Relay)

nWSX NL LV (PIR w/ Night Light, No Relay)

nWSD PDT NL LV (Dual Tech w/ Night Light, No Relay)

nWSD LV or nWSX LV (PIR, No Relay, Raise/Lower Dim Ctrl)

nWSD PDT LV or nWSX PDT LV (Dual Tech w/ Night Light, No Relay, Raise/Lower Dim Ctrl)

u. Network system shall have sensors that can be embedded into luminaire such that only the lens shows on luminaire face.
v. Embedded sensors shall be capable of both PIR and Dual Technology occupancy detection
w. Embedded sensors shall have an optional photocell
x. Embedded sensors shall be the following Sensor Switch model number:

nES 7 (PIR, No Relay)
nES 7 ADCX (PIR w/ Photocell, No Relay)
nES PDT 7 (Dual Technology, No Relay)
nES PDT 7 ADCX (Dual Technology w/ Photocell, No Relay)

y. Network system shall also have ceiling, fixture, recessed, & corner mounted sensors available.
z. Fixture mount sensors shall be capable of powering themselves via a line power feed.
aa. Sensors shall have optional features for photocell/daylight override, dimming control, and low temperature/high humidity operation.
bb. Sensors with dimming can control 0 to 10 VDC dimmable ballasts by sinking up to 20 mA of Class 2 current (typically 40 or more ballasts).
cc. Sensors shall be the following Sensor Switch model numbers, with device options as specified:

Model # Series	Occupancy Poles	# of Relays	Lens Type	Detection Technology
nCM(B) 9	1	-	Standard	PIR
nCM(B) 9 2P	2	-	Standard	PIR
nCMR(B) 9	1	1	Standard	PIR
nCMR(B) 9 2P	2	2	Standard	PIR
nCM(B) PDT 9	1	-	Standard	Dual
nCM(B) PDT 9 2P	2	-	Standard	Dual
nCMR(B) PDT 9	1	1	Standard	Dual
nCMR(B) PDT 9 2P	2	2	Standard	Dual
nCM(B) 10	1	-	Extended	PIR
nCM(B) 10 2P	2	-	Extended	PIR
nCMR(B) 10	1	1	Extended	PIR
nCMR(B) 10 2P	2	2	Extended	PIR
nCM(B) PDT 10	1	-	Extended	Dual
nCM(B) PDT 10 2P	2	-	Extended	Dual
nCMR(B) PDT 10	1	1	Extended	Dual
nCMR(B) PDT 10 2P	2	2	Extended	Dual
nWV 16	1	-	Wide View	PIR
nWV PDT 16	1	-	Wide View	Dual
nHW13	1	-	Hallway	PIR
nCM(B) 6	1	-	High Bay	PIR
nCMR(B) 6	1	1	High Bay	PIR
nCMR(B) 6 2P	2	2	High Bay	PIR
nCMR(B) 6 480	1	2	High Bay	PIR

Note: Recessed mount versions of the above ceiling(fixture) mount versions also shall be available (e.g. nCMR(B) 9 => nRMR 9)

bb. System shall have WiFi enabled fixture mountable sensors available.

cc. Embedded sensors shall have an optional photocell and 0-10 VDC dimming output

dd. WiFi enable sensors shall be one of the Sensor Switch model numbers:

nCMRB 6 WIFI (PIR, w/ Relay)
nCMRB 10 WIFI (PIR, w/ Relay)
nCMRB 50 WIFI (PIR, w/ Relay)
nCMRB 9 WIFI (PIR, w/ Relay)

C. Networked System Daylight (Photocell and or Dimming) Sensors

a. Photocell shall provide for an on/off set-point, and a deadband to prevent the artificial light from cycling. Delay shall be incorporated into the photocell to prevent rapid response to passing clouds.
b. Photocell and dimming sensor's set-point and deadband shall be automatically calibrated through the sensor's microprocessor by initiating an "Automatic Set-point Programming" procedure. Min and max dim settings as well as set-point may be manually entered.
c. Deadband setting shall be verified and modified by the sensor automatically every time the lights cycle to accommodate physical changes in the space (i.e., furniture layouts, lamp depreciation, or lamp outages).
d. Dimming sensors shall control 0 to 10 VDC dimmable ballasts by sinking up to 20 mA of class 2 current (typically 40 or more ballasts).
e. Photocell and dimming sensors shall be equipped with an automatic override for 100 hour burn-in of lamps. This feature must be available at any time for lamp replacements. (Note: This function should be performed prior to any dimming of the lamps including the "auto set-point" setting.)
f. Combination units that have all features of on/off photocell and dimming sensors shall also be available.
g. A dual zone option shall be available for On/Off Photocell, Automatic Dimming Control Photocell, or Combination units. The second zone shall be capable of being controlled as an "offset" from the primary zone.
h. Line voltage versions of the above described photocell and combination photocell/dimming sensors shall be capable of switching both 120 VAC, 277 VAC, and 347 VAC. Load ratings shall be 800 W @ 120 VAC, 1200 W @ 277 VAC, 1500 W @ 347 VAC, and ¼ HP motor load. Relays shall be dry contacts.
i. Sensor shall be the following Sensor Switch model numbers, with device options as specified:

nCM(B) PC (on/off))

nCM(B) ADC (dimming)

nCM(B) PC ADC (on/off, 0-10 VDC dimming)

nCMR(B) PC (on/off, single relay)

nCMR(B) PC ADC (on/off, 0-10 VDC dimming, single relay)

Note: Recessed mount versions of the above ceiling(fixture) mount versions also shall be available (e.g. nCMR(B) PC => nRMR PC)

j. Network system shall have dimming photocells that can be embedded into luminaire such that only the lens shows on luminaire face.
k. Embedded sensors shall be the following Sensor Switch model number:

nES ADCX (Dimming Photocell)

D. Networked System Power (Relay) Packs

a. Power Pack shall incorporate one or more Class 1 relays and contribute low voltage power to the rest of the system. Secondary Packs shall incorporate the relay(s), shall have an optional 2nd relay, 0-10 VDC dimming output, or line voltage dimming output, but shall not be required to contribute system power. Power Supplies shall provide system power only, but are not required to switch line voltage circuit. Auxiliary Relay Packs shall switch low voltage circuits only.
b. Power Packs shall accept 120 or 277 VAC (or optionally 347 VAC), be plenum rated, and provide Class 2 power to the system.
c. All devices shall have two RJ-45 ports.
d. Every Power Pack parameter shall be available and configurable remotely from the software and locally via the device push-button.
e. Power Pack shall securely mount to junction location through a threaded ½ inch chase nipple or be capable of being secured within a luminaire ballast channel. Plastic clips into junction box shall not be accepted. All Class 1 wiring shall pass through chase nipple into adjacent junction box without any exposure of wire leads. Note: UL Listing under Energy Management or Industrial Control Equipment automatically meets this requirement, whereas Appliance Control Listing does not meet this safety requirement.
f. When required by local code, Power Pack must install inside standard electrical enclosure and provide UL recognized support to junction box. All Class 1 wiring is to pass through chase nipple into adjacent junction box without any exposure of wire leads.
g. Power Packs and Power Supplies shall be available that are WiFi enabled.
h. Power (Secondary) Packs shall be available that provide up to 16 Amp switching of all lighting load types.
i. Power (Secondary) Packs shall be available that provide up to 5 Amps switching of all lighting load types as well as 0-10 VDC dimming or fluorescent ballasts/LED drivers.
j. Specific Secondary Packs shall be available that provide up to 5 Amps of switching as well as 0-10 VDC dimming of fluorescent ballasts/LED drivers.
k. Specific Secondary Packs shall be available that provide up to 5 Amps of switching and can dim 120 VAC incandescent lighting loads or 120/277 VAC line voltage dimmable fluorescent ballasts (2-wire and 3-wire versions).
l. Specific Secondary Packs shall be available that provide up to 5 Amps of switching and can dim 120/277 VAC magnetic low voltage transformers.
m. Specific Secondary Packs shall be available that provide up to 4 Amps of switching and can dim 120 VAC electronic low voltage transformers.
n. Specific Secondary Packs shall be available that provide up to 5 Amps of switching of dual phase (208/240/480 VAC) lighting loads.
o. Specific Secondary Packs shall be available that require a manual switch signal (via a networked Wall Station) in order to close its relay.
p. Specific Power/Secondary Packs shall be available that are UL924 listed for switching of Emergency Power circuits.
q. Specific Secondary Packs shall be available that control louver/damper motors for skylights.
r. Specific Secondary Packs shall be available that provide a pulse on/pulse off signal for purposes of controlling shade systems via relay inputs.
s. Power (Relay) Packs and Supplies shall be the following Sensor Switch model Series:

nPP16 (Power Pack w/ 16A relay)

nPP16 WIFI (Power Pack w/ 16A relay, WIFI enabled)

nEPP5 D (Power Pack w/ 5A relay and 0-10VDC dimming output)

nSP16 (Secondary Pack w/ 16A relay)

nSP5 2P (Secondary Pack w/ two 5A relays)

nSP5 D (Secondary Pack w/ 5A relay and 0-10VDC dimming output)

nPP16 ER (UL924 Listed Secondary Pack w/ 16A relay for switching emergency power circuits)

nSP5 D ER (UL924 Listed Secondary Pack w/ 5A relay and 0-10VDC dimming output for switching emergency power circuits)

nSP5 PCD 2W (Secondary Pack w/ 5A relay and incandescent dimming or 2-wire line voltage fluorescent dimming output)

nSP5 PCD 3W (Secondary Pack w/ 5A relay and 3-wire line voltage fluorescent dimming output)

nSP5 PCD MLV (Secondary Pack w/ 5A relay and magnetic low voltage dimming output)

nSP5 PCD ELV 120 (Secondary Pack w/ 4A relay and electronic low voltage dimming output)

nSP5 480 (Secondary Pack w/ 5A relay for switching 208/240/480 VAC loads

nSP5 2P LVR (Louver/Damper Control Pack

nSHADE (Pulse On/Off Control Pack

nPS 80 (Auxiliary Bus Power Supply)

nPS 80 WIFI (Auxiliary Bus Power Supply, WiFi enabled)

nAR 40 (Low voltage auxiliary relay pack)

E. Networked System Relay & Dimming Panels

dd. Panel shall incorporate up to 4 normally closed latching relays capable of switching 120/277 VAC or up to 2 Dual Phase relays capable of switching 208/240/480 VAC loads.
ee. Relays shall be rated to switch up to a 30A ballast load at 277 VAC.
ff. Panel shall provide one 0-10VDC dimming output paired with each relay.
gg. Panel shall power itself from an integrated 120/277 VAC supply.
hh. Panel shall be capable of operating as either two networked devices or as one.
ii. Panel shall supply current limited low voltage power to other networked devices connected via CAT-5.
jj. Panel shall provide auxiliary low voltage device power connected wired directly to a dedicated terminal connection
kk. Power (Relay) Packs and Supplies shall be the following Sensor Switch model numbers:

nPANEL 4 (Panel w/ four 120/277 VAC relays and four 0-10 VDC dimming outputs)

nPANEL 2 480 (Panel w/ two dual phase relays (208/240/480 VAC) and two 0-10

VDC dimming outputs)

F. Networked Auxiliary Input / Output (I/O) Devices

a. Devices shall be plenum rated and be inline wired, screw mountable, or have an extended chase nipple for mounting to a ½” knockout.
b. Devices shall have two RJ-45 ports
c. Communication and low voltage power shall be delivered to each device via standard CAT-5 low voltage cabling with RJ-45 connectors.

d. Specific I/O devices shall have a dimming control output that can control 0-10 VDC dimmable ballasts or LED drivers by sinking up to 20 mA of current (typically 40 or more ballasts).
e. Specific I/O devices shall have an input that read a 0-10 VDC signal from an external device.
f. Specific I/O devices shall have a switch input that can interface with either a maintained or momentary switch and run a switch event, run a local/remote control profile, or raise/lower a dimming output
g. Specific I/O devices shall sense state of low voltage outdoor photocells
h. Specific I/O devices shall enable RS-232 communication between lighting control system and Touch Screen based A/V control systems.
i. Specific I/O devices shall sense .
j. Auxiliary Input/Output Devices shall be the following Sensor Switch model numbers:

nIO D (I/O device with 0-10 dimming output)

nIO 1S or nIO RLX (I/O device with contact closure or 0-10VDC dimming input)

nIO NLI (Input device for detecting state of low voltage outdoor photocell; sold in

nIO PC KIT only)

nIO X (Interface device for communicating with RS-232 enabled AV Touch

Screens

G. Networked LED Luminaires

a. Networked LED luminaire shall have a mechanically integrated control device
b. Networked LED luminaire shall have two RJ-45 ports
c. Networked LED luminaire shall be able to digitally network directly to other network control devices (sensors, photocells, switches, dimmers)
d. Networked LED luminaire shall provide low voltage power to other networked control devices
e. System shall be able to turn on/off LED luminaire without using a relay
f. System shall be able to maintain constant lumen output over the specified life of the LED luminarie (also called lumen compensation) by varying the input control power (and thus saving up to 20% power usage).
g. System shall indicate (via a blink warning) when the LED luminaire has reached its expected life (in hrs).
k. LED Luminaires shall be the following Lithonia model families:

RTLED

TLED

VLED

ACLED

AL LED

WLED

STLED

MINO

H. Networked System Wall Switches & Dimmers

a. Devices shall recess into single-gang switch box and fit a standard GFI opening.
b. Devices shall be available with zero or one integrated Class 1 switching relay.
c. Communication and low voltage power shall be delivered to each device via standard CAT-5 low voltage cabling with RJ-45 connectors.

d. All sensors shall have two RJ-45 ports.
e. All devices shall provide toggle switch control. Dimming control and low temperature/high humidity operation are available options.
f. Devices shall be available in four colors (Ivory, White, Light Almond, Gray).
g. Devices with dimming control outputs can control 0-10 VDC dimmable ballasts by sinking up to 20 mA of current (typically 40 or more ballasts).
h. Devices with capacitive touch buttons shall provide audible user feedback with different sounds for on/off, raise/lower, start-up, and communication offline.
i. Devices with mechanical push-buttons shall provide tactile and LED user feedback.
j. Devices with mechanical push-buttons shall be made available with custom button labeling
k. Devices with a single on button shall be capable of selecting all possible lighting combinations for a bi-level lighting zone such that the user confusion as to which of two buttons (as is present in multi-button scenarios) controls which load is eliminated.
l. Wall switches & dimmers shall be the following Sensor Switch model numbers, with device options as specified:

nPOD (single on/off, capacitive touch, audible user feedback)

nPOD 2P (dual on/off, capacitive touch, audible user feedback)

nPODR (single on/off, one relay, capacitive touch, audible user feedback)

nPODM (single on/off, push-buttons, LED user feedback)

nPODM 2P (dual on/off, push-buttons, LED user feedback)

nPODM DX (single on/off, single dimming raise/lower, push-buttons, LED user feedback)

nPODM 2P DX (dual on/off, dual dimming raise/lower, push-buttons, LED user feedback)

nPODM 4P (quad on/off, push-buttons, LED user feedback)

nPODM 4P DX (quad on/off, quad dimming raise-lower, push-buttons, LED user feedback)

I. Networked System Graphic Wall Station

a. Device shall have a 3.5” full color touch screen for selecting up to 8 programmable lighting control presets or acting as up to 16 on/off/dim control switches.
b. Device shall enable configuration of lighting presets, switched, and dimmers via password protected setup screens.
c. Device shall enable user supplied .jpg screen saver image to be uploaded.
d. Device shall surface mount to single-gang switch box
e. Device shall have a micro-USB style connector for local computer connectivity.
f. Device shall have two RJ-45 ports for communication
g. Device shall be the following Sensor Switch model number:

nPOD GFX

J. Networked System Scene Controllers

a. Device shall have two to four buttons for selecting programmable lighting control profiles or acting as on/off switches.
b. Device shall recess into single-gang switch box and fit a standard GFI opening.
c. Devices shall provide LED user feedback.
d. Communication and Class 2 low voltage power shall be delivered to each device via standard CAT-5 low voltage cabling with RJ-45 connectors.
e. All sensors shall have two RJ-45 ports.

f. Device shall be capable of reprogramming other devices in its zone so as to implement user selected lighting scene.
g. Device shall be capable of selecting a lighting profile be run by the system's upstream Gateway so as to implement selected lighting profile across multiple zones (and not just its local zone).
h. Device shall have LEDs indicating current selection.
i. Scene Selector device shall be the following Sensor Switch model number:

nPODM 2S (2 Scene, push-button)
nPODM 4S (4 Scene, push-button)
nPODM 4S DX (4 Scene, push-button, On/Off/Raise/Lower)
nPODM 4L DX (4 Adjustable Presets, push-button, On/Off/Raise/Lower)

K. Communication Bridges

a. Device shall surface mount to a standard 4" x 4" square junction box.
b. Device shall have 8 RJ-45 ports.
c. Device shall be capable of aggregating communication from multiple lighting control zones for purposes of minimizing backbone wiring requirements back to Control Gateway.
d. Device shall be powered with Class 2 low voltage supplied locally via a directly wired power supply or delivered via a CAT-5 cabled connection.
e. Device shall be careful of redistributing power from its local supply and connect lighting control zones with excess power to lighting control zones with insufficient local power. This architecture also enables loss of power to a particular area to be less impactful on network lighting control system.
f. Communication Bridge devices shall be the following Sensor Switch model numbers:

nBRG 8 (8 Ports)

2.4. LIGHTING CONTROL PROFILES

A. Changes to the operation of the system shall be capable of being made in real-time or scheduled via lighting control profiles. These profiles are outlines of settings that direct how a collection of devices function for a defined time period.
B. Lighting control profiles shall be capable of being created and applied to a single device, zone of devices, or customized group of zones.
C. All relays and dimming outputs shall be capable of being scheduled to track or ignore information regarding occupancy, daylight, and local user switches via lighting control profiles.
D. Every device parameter (e.g. sensor time delay and photocell set-point) shall be configurable via a lighting control profile.
E. All lighting control profiles shall be stored on the network control gateway device and on the software's host server.
F. Lighting control profiles shall be capable of being scheduled to run according to the following calendar options: start date/hour/minute, end date/hour/minute, and sunrise/sunset +/- timed offsets.
G. Sunrise/sunset times shall be automatically derived from location information using an astronomical clock.
H. Daylight savings time adjustments shall be capable of being performed automatically, if desired.
I. Lighting control profile schedules shall be capable of being given the following recurrence settings: daily, weekday, weekend, weekly, monthly, and yearly.
E. Software shall provide a graphical tool for easily viewing scheduled lighting control profiles.

2.5. MANAGEMENT SOFTWARE

A. Every device parameter (e.g. sensor time delay and photocell set-point) shall be available and configurable remotely from the software
B. The following status monitoring information shall be made available from the software for all devices for which it is applicable: current occupancy status, current PIR Status, current Microphonics Status, remaining occupancy time delay(s), current photocell reading, current photocell inhibiting state, photocell transitions time remaining, current dim level, device temperature, and device relay state(s).
C. The following device identification information shall be made available from the software: model number, model description, serial number, manufacturing date code, custom label(s), and parent network device.
D. A printable network inventory report shall be available via the software.
E. A printable report detailing all system profiles shall be available via the software.
F. Software shall require all users to login with a User Name and Password.
G. Software shall provide at least three permission levels for users.
H. All sensitive stored information and privileged communication by the software shall be encrypted.
I. All device firmware and system software updates must be available for automatic download and installation via the internet.
J. Software shall be capable of managing systems interconnected via a WAN (wide area network).
K. Programming language and computing platform shall be HTML-based. JavaScript is not allowed.

2.6. BMS COMPATIBILITY

A. System shall provide a BACnet IP gateway as a downloadable software plug-in to its management software. No additional hardware shall be required.
B. BACnet IP gateway software shall communicate information gathered by networked system to other building management systems.
C. BACnet IP gateway software shall translate and forward lighting relay and other select control commands from BMS system to networked control devices.

2.7. SYSTEM ENERGY ANALYSIS & REPORTING SOFTWARE

A. System shall be capable of reporting lighting system events and performance data back to the management software for display and analysis.
B. Intuitive graphical screens shall be displayed in order to facilitate simple viewing of system energy performance.
C. An “Energy Scorecard” shall be display that shows calculated energy savings in dollars, KWHr, or CO_2.
D. Software shall calculate the allocation of energy savings to different control measures (occupancy sensors, photocells, manual switching, etc).
E. Energy savings data shall be calculated for the system as a whole or for individual zones.
F. A time scaled graph showing all relay transitions shall be presented.
G. A time scaled graph showing a zones occupancy time delay shall be presented
H. A time scaled graph showing the total light level shall be presented.
I. User shall be able to customize the baseline run-time hours for a space.
J. User shall be able to customize up to four time-of-day billing rates and schedules.
K. Data shall be made available via a .CSV file

2.8. START-UP & SUPPORT FEATURES

A. To facilitate start-up, all devices daisy-chained together (using CAT-5) shall automatically be grouped together into a functional lighting control zone.

B. All lighting control zones shall be able to function according to default settings once adequate power is applied and before any system software is installed.
C. Once software is installed, system shall be able to auto-discover all system devices without requiring any commissioning.
D. All system devices shall be capable of being given user defined names.
E. All devices within the network shall be able to have their firmware reprogrammed remotely and without being physically uninstalled for purposes of upgrading functionality at a later date.
F. All sensor devices shall have the ability to detect improper communication wiring and blink it's LED in a specific cadence as to alert installation/startup personnel.

PART 3 - EXECUTION

3.1 WIRING INSTALLATION

A. Comply with NECA 1.

B. Wiring Method: Install cables in raceways except within consoles and cabinets and except in accessible ceiling spaces where unenclosed wiring method may be used. Conceal raceway and cables except in unfinished spaces.

1. Install plenum cable in environmental airspaces, including plenum ceilings.
2. Comply with requirements for raceways specified in Section 26 0110 "Conduit Raceways."
3. Cables installed above accessible ceilings shall be installed in a neat workmanlike manner at right angle to structure.
4. Provide j-hooks for support of cables above accessible ceiling space.

C. 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.

3.2 IDENTIFICATION

A. Identify system components, wiring, cabling, boxes, cabinets, and terminals.

B. Identify all ceiling-mounted controls with data bus number and device address.

C. Label each device cable within 6 inches (152 mm) of connection to bus power supply or termination block.

3.3 FIELD QUALITY CONTROL

A. Acceptance Testing Preparation:

1. Test continuity of each circuit.

B. Perform the following tests and inspections with the assistance of a factory-authorized service representative:

1. Test each bus controller using local and remote controls.

2. Perform each visual and mechanical inspection and electrical test stated in NETA ATS. Certify compliance with test parameters.
3. Correct malfunctioning units on-site, where possible, and retest to demonstrate compliance; otherwise, replace with new units and retest.

C. Field Test Reports:

1. Printed list of all points created from actual queries of all addressed control points to include lamps, ballasts, manual controls, and sensors.
2. Event log verifying the performance of all devices generating event messages to include occupancy sensors, control buttons, alarm messages, and any other change of value messages.

D. Lighting controls will be considered defective if they do not pass tests and inspections.

E. Prepare test and inspection reports, including a certified report that identifies bus controllers included and describes query results. Include notation of deficiencies detected, remedial action taken, and observations made after remedial action.

3.4 STARTUP SERVICE

A. Engage a factory-authorized service representative to perform startup service.

1. Complete installation and startup checks according to manufacturer's written instructions.
2. Activate luminaires and verify that all lamps are operating at 100 percent.
3. Confirm correct communications wiring, initiate communications between DALI devices and controller/gateways, and program the lighting control system according to approved configuration schedules, time-of-day schedules, and input override assignments.

3.5 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 four visits to Project during other-than-normal occupancy hours for this purpose.

3.6 SOFTWARE SERVICE AGREEMENT

A. Technical Support: Beginning at Substantial Completion, service agreement shall include software support for five years.

B. Upgrade Service: At Substantial Completion, update software to latest version. Install and program software upgrades that become available within five years 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.

3.7 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain the control unit and operator interface.

3.8 OPERATIONS TRAINING

A. The contractor shall provide and implement a complete and comprehensive staff training program for all administrators, facility staff members, and teachers. This mandatory training program will provide school staff a complete understanding of how to utilize and properly operate all functions

B. The training program shall be implemented by a staff member/trainer employed by the contractor. The trainer must be factory certified to provide training on their product.

C. All staff development training is to be coordinated through the owner's designated representative. As training sessions are completed, the trainer will provide the school's administrative staff and school district's staff a document listing all of the staff and faculty members who attended, received, and completed the training program.

D. Video tape training and provide electronic file of video to the Davis School District.

3.9 MAINTENANCE AND REPAIR TRAINING

A. The contractor shall provide and implement a complete and comprehensive training program for all maintenance personnel. This mandatory training program will provide a complete understanding of how to maintain and repair the system.

B. The training program shall be implemented by a factory trained certified technician on the school site. Two (2) maintenance personnel from the Davis School District shall be trained to a "certified" level and receive a certificate.

C. All training is to be coordinated through the owner's designated representative. As training sessions are completed, the trainer will provide the school's administrative staff and school district's staff a document listing all of the maintenance personnel who attended, received, and completed the training program.

END OF SECTION 26 05 60

SECTION 26 08 00 – COMMISSIONING & TESTING OF ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section includes work related to the commissioning and testing of electrical systems covered under Divisions 26, 27 and 28. For the specific commissioning and testing requirements of each electrical system, refer to individual electrical system specifications.

B. The commissioning authority shall review and approve all test procedures, forms, and have ability to attend the commissioning and testing activities conducted as part of the contract.

C. Where commissioning is required under other divisions that relate to electrical, such as mechanical and plumbing divisions (Division 22, 23, and 25), the contractor shall include all related electrical commissioning and testing to complete the commissioning and testing under other divisions.

D. The purpose of the commissioning and testing of electrical systems is to demonstrate that the equipment and systems are ready and safe for operation and that they are performing to the intended design level and/or intent.

1.3 ELECTRICAL SYSTEMS TO BE COMMISSIONED/TESTED

A. Commission and/or test the following electrical systems in compliance with section requirements:
1. Section 260140 – Wiring Devices
2. Section 260180 – Overcurrent Protective Devices
3. Section 260289 – Surge Protection Devices
4. Section 260560 – Network Lighting Control System
5. Section 262713 – Electricity Metering
6. Section 271500 – Communications Horizontal Cabling
7. Section 273100 – Public Safety Distributed Antenna Systems
8. Section 275115 – Audio Systems
9. Section 275117 – Video Systems
10. Section 275123 – Educational Intercommunication and Program Systems
11. Section 280721 – Digital, Addressable Fire-Alarm System
12. Section 280730 – Access Control Systems
13. Section 282300 – Video Surveillance

1.4 DEFINITIONS

A. CTC: Certified Testing Company.

B. NETA ATS: Acceptance Testing Specification.

1.5 ACTION SUBMITTALS

A. Not Required.

1.6 INFORMATIONAL SUBMITTALS

A. For each system to be commissioned and tested, submit the commissioning/testing procedures, list of equipment, modes to be tested, and CTS. Include all forms, checklists, and report formats that will be used to collect, record, and demonstrate the commissioning and testing has been completed in compliance with the contract documents.

B. Qualification Data: For certified testing agency.

C. Field quality-control commissioning and testing/reports.

1.7 QUALITY ASSURANCE

A. Testing Agency Qualifications: Member company of NETA or an NRTL.

1. Testing Agency's Field Supervisor: Certified by NETA to supervise on-site testing.

PART 2 - PRODUCTS

2.1 TEST EQUIPMENT

A. Industry standard testing equipment shall be used to perform start-up, initial check-out, prefunctional, and required functional testing applicable to the equipment or system being commissioned and/or tested.

B. Test equipment shall be of the quality and accuracy required to test and/or measure system performance with the tolerances specified or established by industry standards and shall have been calibrated within the last 12 months or as specified herein. Equipment shall be calibrated according to the recommended manufacturer intervals and when damaged, dropped, or reading are in question. Calibration tags shall be affixed or certificates of calibration available upon request.

PART 3 - EXECUTION

3.1 PREFUNCTIONAL TESTING

A. Conduct prefunctional testing as required, make remedies and adjustments to the equipment or systems as determined until the prefunctional testing has been completed with acceptable results.

B. Follow the approved prefunctional testing and check-out procedures.

C. This testing shall be completed prior to energizing and start-up of equipment and systems.

D. Submit prefunctional test reports and obtain approval from the commissioning authority prior to proceeding to start-up.

3.2 START-UP

A. Complete start-up checklists and follow the manufacturer's published instructions for start-up of equipment and systems.

B. Submit start-up checklists, and reports with data collected during start-up.

3.3 REMEDIES AND RETESTING

A. Provide adjustments to settings, corrections to installations, and corrections to equipment and systems as required until they are operating as designed and within acceptable performance levels.

B. Complete retesting of equipment and systems where changes are made.

C. The correction and retesting sequences shall continue until acceptable performance levels and the proper operation of the equipment and systems have been met.

3.4 OWNER TRAINING

A. Conduct required owner trainings for the required equipment and systems in accordance with each section.

B. Trainings shall be video recorded, submit (3) electronic copies of the training video recording to the Owner within the O&M manuals. The Video format shall be a standard format that can be viewed on any DVD player.

3.5 DOCUMENTATION AND O&M MANUALS

A. Submit documentation as requested to demonstrate compliance with the commissioning and testing requirements of equipment and systems

B. Include copies of commissioning and testing checklists, reports, data collected, final settings, and other pertinent data within the Owners O&M manuals.

END OF SECTION 26 08 00

SECTION 26 22 00 – LOW-VOLTAGE TRANSFORMERS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes the following types of dry-type transformers rated 600 V and less, with capacities up to 1000 kVA:

1. Distribution transformers.

1.3 ACTION SUBMITTALS

A. Product Data: Include rated nameplate data, capacities, weights, dimensions, minimum clearances, installed devices and features, and performance for each type and size of transformer indicated.

B. Shop Drawings: Detail equipment assemblies and indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.

1. Wiring Diagrams: Power, signal, and control wiring.

1.4 INFORMATIONAL SUBMITTALS

A. Manufacturer Seismic Qualification Certification: Submit certification that transformers, accessories, and components will withstand seismic forces defined in Section 260548.16 "Seismic Controls for Electrical Systems." Include the following:

1. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.

   a. The term "withstand" means "the unit will remain in place without separation of any parts from the device when subjected to the seismic forces specified."

2. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.
3. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.

B. Qualification Data: For testing agency.

C. Source quality-control test reports.

D. Field quality-control test reports.

1.5 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For transformers to include in emergency, operation, and maintenance manuals.

1.6 QUALITY ASSURANCE

A. Testing Agency Qualifications: An independent agency, with the experience and capability to conduct the testing indicated, that is a nationally recognized testing laboratory (NRTL) as defined by OSHA in 29 CFR 1910.7.

B. Source Limitations: Obtain each transformer type through one source from a single manufacturer.

C. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

D. Comply with IEEE C57.12.91, "Test Code for Dry-Type Distribution and Power Transformers."

1.7 DELIVERY, STORAGE, AND HANDLING

A. Temporary Heating: Apply temporary heat according to manufacturer's written instructions within the enclosure of each ventilated-type unit, throughout periods during which equipment is not energized and when transformer is not in a space that is continuously under normal control of temperature and humidity.

1.8 COORDINATION

A. Coordinate size and location of concrete bases with actual transformer provided. Cast anchor-bolt inserts into bases. Concrete, reinforcement, and formwork requirements are specified with concrete.

B. Coordinate installation of wall-mounting and structure-hanging supports with actual transformer provided.

PART 2 - PRODUCTS

2.1 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:

B. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Acme Electric Corporation.

2. Challenger Electrical Equipment Corp.
3. Controlled Power Company.
4. Eaton Electrical Sector; Eaton Corporation; Cutler-Hammer Products.
5. Federal Pacific Transformer Company.
6. General Electric Company / ABB.
7. Hammond Co.
8. Magnetek Power Electronics Group.
9. Micron Industries Corp.
10. Myers Power Products, Inc.
11. Siemens Energy & Automation, Inc.
12. Sola/Hevi-Duty.
13. Square D Co./Groupe Schneider NA; Schneider Electric.
14. Powersmiths International Corp.

2.2 GENERAL TRANSFORMER REQUIREMENTS

A. Description: Factory-assembled and -tested, air-cooled units for 60-Hz service.

B. Cores: Grain-oriented, non-aging silicon steel.

C. Coils: Continuous windings without splices except for taps.

1. Internal Coil Connections: Brazed or pressure type.
2. Coil Material: Aluminum.

2.3 DISTRIBUTION TRANSFORMERS

A. Comply with NEMA ST 20, and list and label as complying with UL 1561.

B. Provide transformers that are constructed to withstand seismic forces specified in Section 260548.16 "Seismic Controls for Electrical Systems."

C. Cores: One leg per phase.

D. Enclosure: Ventilated, NEMA 250, Type 2.

1. Core and coil shall be encapsulated within resin compound, sealing out moisture and air.

E. Transformer Enclosure Finish: Comply with NEMA 250.

1. Finish Color: Gray.

F. Taps for Transformers Smaller than 3 kVA: One 5 percent tap above normal full capacity.

G. Taps for Transformers 7.5 to 24 kVA: One 5 percent tap above and one 5 percent tap below normal full capacity.

H. Taps for Transformers 25 kVA and Larger: Two 2.5 percent taps above and two 2.5 percent taps below normal full capacity.

I. Insulation Class: 220 deg C, UL-component-recognized insulation system with a maximum of 150 deg C rise above 40 deg C ambient temperature.

J. Energy Efficiency for Transformers Rated 15 kVA and Larger:

1. NEMA TP-1.

K. K-Factor Rating: Transformers indicated to be K-factor rated shall comply with UL 1561 requirements for nonsinusoidal load current-handling capability to the degree defined by designated K-factor.

1. Unit shall not overheat when carrying full-load current with harmonic distortion corresponding to designated K-factor.
2. Indicate value of K-factor on transformer nameplate.

L. Electrostatic Shielding: Where indicated on drawings, each winding shall have an 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 the shield.
3. Shield Effectiveness:

a. Capacitance between Primary and Secondary Windings: Not to exceed 33 picofarads over a frequency range of 20 Hz to 1 MHz.
b. Common-Mode Noise Attenuation: Minimum of minus 120 dBA at 0.5 to 1.5 kHz; minimum of minus 65 dBA at 1.5 to 100 kHz.
c. Normal-Mode Noise Attenuation: Minimum of minus 52 dBA at 1.5 to 10 kHz.

M. Wall Brackets: Manufacturer's standard brackets.

N. Fungus Proofing: Permanent fungicidal treatment for coil and core.

O. Low-Sound-Level Requirements: Minimum of 3 dBA less than NEMA ST 20 standard sound levels when factory tested according to IEEE C57.12.91.

2.4 IDENTIFICATION DEVICES

A. Nameplates: Engraved, laminated-plastic or metal nameplate for each distribution transformer, mounted with corrosion-resistant screws.

2.5 SOURCE QUALITY CONTROL

A. Test and inspect transformers according to IEEE C57.12.91.

B. Factory Sound-Level Tests: Conduct sound-level tests on equipment for this Project.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine conditions for compliance with enclosure- and ambient-temperature requirements for each transformer.

B. Verify that field measurements are as needed to maintain working clearances required by NFPA 70 and manufacturer's written instructions.

C. Examine walls, floors, roofs, and concrete bases for suitable mounting conditions where transformers will be installed.

D. Verify that ground connections are in place and requirements in Section 260526 "Grounding and Bonding for Electrical Systems" have been met. Maximum ground resistance shall be 5 ohms at location of transformer.

E. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Install wall-mounting transformers level and plumb with wall brackets fabricated by transformer manufacturer.

1. Brace wall-mounting transformers as specified in Section 260072, "Electrical Supports and Seismic Restraints."

B. Construct concrete bases and anchor floor-mounting transformers according to manufacturer's written instructions, seismic codes applicable to Project, and requirements in Section 260072, “Electrical Supports and Seismic Restraints.”

3.3 CONNECTIONS

A. Ground equipment according to Section 260452 "Grounding,”

B. Connect wiring according to Section 260120 "Conductors and Cables."

3.4 FIELD QUALITY CONTROL

A. Testing Agency: Engage a qualified testing agency to perform tests and inspections and prepare test reports.

B. Perform tests and inspections and prepare test reports.

C. Tests and Inspections:

1. Perform each visual and mechanical inspection and electrical test stated in NETA Acceptance Testing Specification. Certify compliance with test parameters.

D. Remove and replace units that do not pass tests or inspections and retest as specified above.

E. Infrared Scanning: Two months after Substantial Completion, perform an infrared scan of transformer connections.

1. Use an infrared-scanning device designed to measure temperature or detect significant deviations from normal values. Provide documentation of device calibration.
2. Perform 2 follow-up infrared scans of transformers, one at 4 months and the other at 11 months after Substantial Completion.

3. Prepare a certified report identifying transformer checked and describing results of scanning. Include notation of deficiencies detected, remedial action taken, and scanning observations after remedial action.

F. Test Labeling: On completion of satisfactory testing of each unit, attach a dated and signed "Satisfactory Test" label to tested component.

3.5 ADJUSTING

A. Record transformer secondary voltage at each unit for at least 48 hours of typical occupancy period. Adjust transformer taps to provide optimum voltage conditions at secondary terminals. Optimum is defined as not exceeding nameplate voltage plus 10 percent and not being lower than nameplate voltage minus 3 percent at maximum load conditions. Submit recording and tap settings as test results.

B. Output Settings Report: Prepare a written report recording output voltages and tap settings.

3.6 CLEANING

A. Vacuum dirt and debris; do not use compressed air to assist in cleaning.

END OF SECTION 26 22 00

SECTION 26 27 13 – 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 for Owner electricity metering.

1.3 DEFINITIONS

A. 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.

B. PC: Personal computer.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product indicated.

B. Shop Drawings: For electricity-metering equipment.

1. Dimensioned plans and sections or elevation layouts.
2. Wiring 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.

1.5 INFORMATIONAL SUBMITTALS

A. Field quality-control reports.

1.6 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data. In addition to items specified in Section 017823 "Operation and Maintenance Data," include the following:

1. Application and operating software documentation.
2. Software licenses.
3. Software service agreement.
4. Hard copies of manufacturer's operating specifications, design user's guides for software and hardware, and PDF files on CD-ROM of the hard-copy Submittal.

1.7 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.

1.8 DELIVERY, STORAGE, AND HANDLING

A. Receive, store, and handle modular meter center according to NECA 400.

PART 2 - PRODUCTS

2.1 EQUIPMENT FOR ELECTRICITY METERING

A. Basis-of-Design Product: Subject to compliance with requirements, provide Continental Control Systems, LCC, WattNode BACnet energy and power meters or comparable product by one of the following:

1. E-Mon; a division of Hunt Power.
2. National Meter Industries.
3. Osaki Meter Sales, Inc.
4. Electro Industries Gauge Tech - Shark Meters

B. General Requirements for Owner's Meters:

1. Comply with UL 1244.
2. Meters used for billing shall have an accuracy of 0.5 percent of reading, complying with requirements in ANSI C12.20.
3. Modular Meter Center: NEMA 250, Type 1 minimum, with hasp for padlocking or sealing. Size meter center to accommodate the number of meters indicated on the electrical drawings.
4. Identification: Comply with requirements in Section 26 0001 "Electrical General Provision."
5. Memory Backup: Self-contained to maintain memory throughout power outages of 72 hours, minimum.
6. 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.
7. 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. Owner’s protocol is BACnet.

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. 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.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Comply with equipment installation requirements in NECA 1.

B. Install modular meter center according to NECA 400 switchboard installation requirements.

3.2 IDENTIFICATION

A. Comply with requirements for identification specified in Section 26 0001 "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.

END OF SECTION 26 27 13

SECTION 26 32 00 – TURNKEY PHOTOVOLTAIC COLLECTORS (ROOFTOP)

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. This section is a Division 26 General Provisions section, and is part of each Division 26, 27, and 28 sections referring to Turnkey Photovoltaic Collectors (Rooftop).

1.2 DESCRIPTION OF WORK:

A. The following outlines general requirements for Turnkey Photovoltaic Systems:

1. Provide engineered stamped drawings, energy model, shop drawings, and project documentation.
2. Provide a complete fully-operational photovoltaic system consisting of, but not necessarily limited to the following:
   a. Photovoltaic modules.
   b. Combiner boxes, junction boxes, etc.
   c. Power Optimizers.
   d. Inverters.
   e. DC wiring (conduits and conductors) from photovoltaic panels to inverter inputs.
   f. AC wiring (conduits and conductors) from inverter outputs to breakers in distribution panels.
   g. Circuit breakers in AC panelboards as may be required to feed inverter units.
   h. installation, labor, equipment, tools, testing, commissioning, training, etc. for a complete photovoltaic power system.
   i. Commissioning and testing.
   j. On-line monitoring.
3. Specify layout and location of the system at the approved project site to maximize production.
4. Minimize the risk of vandalism, theft and personal injury in the installation and operation of the systems.
5. System layout, spacing, and construction shall comply with all current zoning, building, and fire codes requirements.
6. Other items as may be included in other scope of work documents.

1.3 REFERENCE STANDARDS

A. ASCE 7-10 - Minimum Design Loads for Buildings and Other Structures; 2010.

B. IEC 61215 - Crystalline Silicon Terrestrial Photovoltaic (PV) Modules – Design Qualification and Type Approval; 2005.

C. IEEE 1262-1995 Recommended Practice for Qualifications of Photovoltaic (PV) Modules.

D. IEEE 1547 - Standard for Interconnecting Distributed Resources with Electric Power Systems; 2018.

E. NEC – Article 690 – Solar Photovoltaic (PV) Systems; 2017.

F. NECA 1 - Standard for Good Workmanship in Electrical Construction; National Electrical Contractors Association; 2010.

G. NEMA 250 - Enclosures for Electrical Equipment (1000 Volts Maximum); 2008.

H. NFPA 70 - National Electrical Code; National Fire Protection Association; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.

I. UL 790 - Standard for Standard Test Methods for Fire Tests of Roof Coverings; Current Edition, Including All Revisions.

J. UL 1703 - Flat Plate Photovoltaic Modules and Panels; Current Edition, Including All Revisions.

K. UL 1741 - Inverters, Converters, Controllers and Interconnection System Equipment for Use with Distributed Energy Resources; Current Edition, Including All Revisions.

1.4 ADMINISTRATIVE REQUIREMENTS

A. Coordination:

1. Coordinate arrangement of electrical equipment with the dimensions and clearance requirements of the actual equipment to be installed.
2. Roof-top Arrays: Coordinate layout of photovoltaic modules and mounting systems with roof and associated equipment.
3. Notify Architect of any conflicts with or deviations from the contract documents. Obtain direction before proceeding with work.

B. Pre-installation Meeting: Convene one week prior to commencing work of this section; require attendance of all affected installers. Include adequate instruction on the electrical hazards associated with photovoltaic systems and appropriate safety procedures to be followed.

C. Utility Interconnection:

1. Coordinate design and construction with Rocky Mountain Power and consulting electrical engineer. Comply will all applicable requirements regarding photovoltaic systems.
2. Prepare and submit documentation as required for securing utility interconnection agreement between the School District (Owner) and rocky Mountain Power.
3. Pre-installation Meeting: Convene one week prior to commencing work of this section to review interconnection requirements and details with local power company representative.
4. Coordinate net metering agreement with local power company and consulting electrical engineer.
5. Arrange for inspections and secure permits necessary to obtain local power company approval of system.

1.5 SUBMITTALS

A. Design Documents: Prepare and submit all information required for plan review and permitting by authorities having jurisdiction, including but not limited to plans, electrical diagrams, riser diagrams, mounting details, and description of operation.

B. Product Data: Provide manufacturer's standard catalog pages and data sheets for each product. Include ratings, configurations, standard wiring diagrams, outline and support point dimensions, finishes, weights, service condition requirements, and installed features.

C. Shop Drawings: Include dimensioned plan views and sections indicating locations of system components, required clearances, attachment locations and details, and proposed size, type, and routing of conduits and cables. Include system interconnection schematic diagrams showing all factory and field connections.

D. Energy Model: a complete model showing energy production data for a complete year including anticipated reductions due to shading.

D. Design Data:

1. Include structural calculations, certified by structural engineer, for equipment and mounting system.
2. Include electrical calculations, certified by electrical engineer or qualified electrical contractor, for array and associated equipment other than the basis of design products and configuration.

E. Certify that work of this section does not void roof warranty.

F. Installer's Qualifications: Include evidence of compliance with specified requirements.

G. Manufacturer's Installation Instructions: Indicate application conditions and limitations of use stipulated by product testing agency. Include instructions for storage, handling, protection, examination, preparation, installation, and operation of product.

H. Utility interconnection documentation.

I. Field quality control test reports.

1. Include manufacturer's field reports.

J. Operation and Maintenance Data: Include detailed information on system operation, equipment programming and setup, replacement parts, and recommended maintenance procedures and intervals.

K. Warranty: Submit sample of manufacturer's warranty and documentation of final executed warranty completed in Owner's name and registered with manufacturer.

L. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.

1. Extra Photovoltaic Modules: Ten (10).

1.6 QUALITY ASSURANCE

A. Comply with NFPA 70.

B. Comply with Utility Company requirements for interconnection.

D. Structural Designer Qualifications: Registered structural engineer licensed in the State of Utah.

E. Electrical Designer Qualifications: Registered electrical engineer licensed in the State of Utah and

experienced in the design of photovoltaic systems.

F. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum three years documented experience.

1. Provide 3 references, minimum, with bid.

G. Installer Qualifications: Company specializing in performing the work of this section with minimum five years documented experience with photovoltaic systems of similar size, type, and complexity.

1. Licensed in the State of Utah as a General Electrical Contractor (S200).
2. Licensed in the State of Utah as a Solar Photovoltaic Contractor (S202).
3. Manufacturer's authorized installer.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Store products in manufacturer's unopened packaging, keep dry and protect from damage until ready for installation.

1.8 WARRANTY

A. See Section 01 7800 - Closeout Submittals, for additional warranty requirements.

B. Photovoltaic Modules: Provide a minimum 25-year manufacturer warranty covering repair or replacement due to defective materials or workmanship.

C. Photovoltaic Module Mounting System: Provide minimum 10-year manufacturer warranty covering repair or replacement due to defective materials or workmanship.

D. Photovoltaic Inverters and Other Components: Provide a minimum 10-year manufacturer warranty covering repair or replacement due to defective materials or workmanship.

PART 2 – PRODUCTS

2.1 MANUFACTURERS

A. Subject to compliance with requirements, provide products from one of the following for each component:

B. Photovoltaic Modules:

1. Basis-of-Design Product: REC Twinpeak 2S Mono 72 Series, 380 watt.

2. Subject to compliance with requirements, other products equivalent to the Basis-of-Design Product may also be provided from one of the following for each component:

a. CanadianSolar.
b. Hanwa Q-CELLS.
c. LG Electronics.

C. Photovoltaic Inverters:

1. Basis-of-Design Product: Solaredge Three Phase Inverter with Synergy Technology, Model SE66.6KUS, 480-volt, three-phase output. Inverters must comply with IEEE-1547-2018 and all other Rocky Mountain Power requirements.

2. Subject to compliance with all requirements, other products equivalent to the Basis-of-Design Product may also be provided from one of the following for each component:

   a. SMA.
   b. Yaskawa Solectria Solar

D. Power Optimizer:

1. Basis-of-Design Product: Solaredge P400 for connecting single modules; Solaredge P800p for connecting two (2) modules.

2. Subject to compliance with all requirements, other products equivalent to the Basis-of-Design Product may also be considered, but must be approved during the bidding period by addendum.

E. Photovoltaic Module Mounting Structures:

1. Basis-of-Design Product: 10-degree tilt System with integrated bonding clips and optional roof-pads.

2. Subject to compliance with all requirements, other products equivalent to the Basis-of-Design Product may also be considered, but must be approved during the bidding period by addendum.

3. Provide roof-mounted racking system with anchoring to withstand local wind conditions per all IBC requirements.

F. Source Limitations: For each type of component, furnish products produced by a single manufacturer and obtained from a single supplier.

2.2 INSTALLERS

A. Subject to compliance with all requirements, the system shall be provided by one of the following installation companies:

1. Creative Energies, (801) 487-6489.
2. Gardner Engineering, (801) 689-2618.
4. Intermountain Wind and Solar, Inc. (801) 298-5255.
5. JC Electric, Inc., (801) 391-2024.
6. Solar Ready Solutions, (801) 212-4485.

2.3 PHOTOVOLTAIC SYSTEM REQUIREMENTS

A. Provide complete photovoltaic system consisting of photovoltaic modules and associated balance of system components necessary for connection to facility electrical system.

B. System Description:

1. System includes interconnection with utility grid (grid-tied system).

a. Utility metering configuration: Net metering.

2. System includes monitoring system.

C. Capacity:

1. Total Nominal Rated Power Output of Array: Refer to electrical drawings for energy production requirements. Maximum degradation shall be 1% per year.

D. Size:

1. Array: Designed to fit on roof-top of building.
2. Individual Modules: Not less than 380 W

E. Appearance:

1. Arrange array such that modules are aligned with uniform spacing.
2. Final determination of acceptable appearance is by Owner.

F. Provide photovoltaic system and associated components suitable for wind loads, snow loads, seismic loads, and other structural design considerations of the installed location.

1. Comply with ASCE 7-10.

G. Provide photovoltaic system and associated components suitable for continuous operation under the service conditions at the installed location.

H. Provide products listed, classified, and labeled by Underwriter's Laboratories Inc. (UL) or Intertek (ETL) as suitable for the purpose indicated.

I. Unless specifically indicated to be excluded, provide all required equipment, conduit, boxes, wiring, connectors, hardware, supports, accessories, software, system programming, etc. as necessary for a complete operating system.

J. Arrange equipment to provide minimum clearances in accordance with manufacturer's instructions and NFPA 70.

K. Arrange array to provide adequate access to rear of string(s) for maintenance.

L. Arrange array to minimize shading during peak production periods.

N. Roof-Mounted Arrays:

1. Arrange array such that normal roof drainage is not affected.
2. Arrange array to maintain required safety clearances from edge of roof per IBC or OSHA requirements as may be enforced by Authority Having Jurisdiction.
3. Arrange array to maintain access and clearance requirements for other roof-mounted equipment.
4. Arrange array to avoid spanning of expansion joints.

2.4 PHOTOVOLTAIC MODULES

A. Acceptable Module Types: Monocrystalline silicon flat-plate 72-module PV modules are acceptable.

B. General Requirements:

1. Photovoltaic Modules: Factory assembled; consisting of photovoltaic cells, frame, junction box, cables for series connection, and bypass diodes for shade tolerance; rated for 1000 V DC; listed as complying with UL 1703.
2. Crystalline Silicon Photovoltaic Modules: Comply with IEC 61215.
3. Frame: Anodized aluminum.
4. Factory-Installed Junction Box: Weatherproof, with factory-installed terminals and bypass diodes.
5. Factory-Installed Cables: Type USE-2 or listed photovoltaic (PV) wire with polarized locking connectors.
6. Fire Resistance Rating: UL 790, Class equal to or better than required fire rating of roof.
7. Unless otherwise indicated, specified module performance characteristics are rated under Standard Test Conditions (STC).

2.5 PHOTOVOLTAIC INVERTERS

A. General Requirements:

1. Provide inverter(s) as indicated or as required for connection of the photovoltaic array DC system to the AC system indicated.
2. Inverters: Suitable for the requirements of the connected array; output configuration compatible with connected system; listed as complying with UL 1741; furnished with the following features:
   a. Maximum power point tracking (MPPT).
   b. LCD display.
3. Grid-Tied Inverters: Comply with IEEE 1547, including over/under grid voltage and frequency protection, and anti-islanding protection to automatically disconnect upon loss of utility power and to remain disconnected until utility power restoration has been maintained for five minutes.
4. Total Harmonic Distortion: Less than five percent.
5. Enclosure Environment Type: NEMA 3R.
6. Provide low forward power relays or other protection devices as may be required by local power company that ensures no export of power from each inverter, including inadvertent export (under fault conditions) that could adversely affect protective devices on the local power company network. Coordinate all work with local power company.
7. Shall comply with all NEC rapid-shut down requirements.

2.6 PHOTOVOLTAIC MODULE MOUNTING SYSTEM:

A. General Requirements:

1. Provide complete self-ballasted mounting system compatible with modules including all necessary hardware and accessories.
2. Support Structure and Associated Hardware Materials: 0.050 inch (nominal thickness) mill certified aluminum with stainless steel fasteners.
3. Ballast mounting system with concrete blocks to hold system in place.
3. Wind loading: Meets ASCE 7-05 wind loading criteria for 150 mph minimum.
4. Fire Rating: Meets IBC required fire testing levels and have an A Class fire rating.
5. Mechanical Load Testing: Meets IBC snow loading requirements.

2.7 PHOTOVOLTAIC COMBINER BOXES:

A. Photovoltaic Combiner Boxes:

1. Provide combiner box(es) for termination of strings as indicated or as required for the array configuration installed.
2. Combiner Boxes: Rated for 1000 V DC; current ratings suitable for connected strings; equipped with circuit breakers; listed as complying with UL 1741.
3. Number of Input Circuits: As required for termination of strings, with minimum of 20 percent spare capacity for future expansion.
4. Enclosure: NEMA 250, Type 3R.
5. Provide with capability of current monitoring for individual strings.

2.8 POWER OPTIMIZERS:

A. Power Optimizers:

1. Provide power optimizers for termination of single or two photovoltaic panels as indicated or as required for the array configuration installed.
2. Enclosure: NEMA 250, Type 3R.

2.9 ON-LINE MONITORING:

A. On-line monitoring:

1. Shall display the data from the photovoltaic system via internet connection through a database.
2. The data retrieved from the photovoltaic system such as CO2 savings, module/system output, trees saved, etc. through the web-connected data monitoring system can be viewed publicly online through a link on the DSD website.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verify that field measurements are as shown on the Drawings.

B. Verify that ratings and configurations of system components are consistent with the indicated requirements.

C. Verify that mounting surfaces are ready to receive system components.

D. Verify that conditions are satisfactory for installation prior to starting work.

3.2 PREPARATION

A. Use open circuiting, short circuiting, or opaque covering to disable modules, array or portions of array prior to installation and service.

B. Roof-Mounted Arrays: Protect roof and adjacent roof-mounted items from damage. Provide walking mats and rigid insulation, as necessary.

3.3 INSTALLATION

A. Perform work in a neat and workmanlike manner in accordance with NECA 1.

B. Install products in accordance with manufacturer's instructions.

C. All PV arrays shall be oriented facing from southeast to southwest, at tilt angles for maximum solar energy exposure, but not less than 10 degrees to allow for proper draining. Arrays should be located to prevent shading from trees, utility poles, Overhead power lines, fences, or other structure at any time between 9 am and 3 pm solar time, any day of the year.

D. To promote cooling, to maximize air circulation around PV arrays, and to keep the arrays above the snow line, ground-mounted arrays shall be a minimum of 6 inches between any photovoltaic module and the roof, with no obstruction preventing air flow between (beneath) the array and the roof.

E. Inverters shall be mounted on the roof or as otherwise noted on the drawings. Provide C-Channel mounting frames and hardware as may be required for proper support and seismic restraint to meet all applicable structural codes and to meet all electrical code requirements pertaining to grounding of PV systems. Provide a deferred submittal consisting of a stamped drawing from a licensed structural engineer prior to installation.

F. Install weather seal fittings and flanges where PV panel assemblies penetrate exterior elements such as roofs. Seal around openings to make weathertight.

G. Circuiting Requirements:

1. Wiring Methods:
   a. Unless otherwise indicated, use 1000 Volt Type RPVU PV Photovoltaic single-conductor building wire in suitable raceway for wiring between combiner box(es) and point of interconnection. Use IMC as raceway where exposed to moisture and weather.
   b. Secure exposed cables in accordance with NFPA 70. Where possible, conceal behind array.
   c. Install cables in suitable raceway where readily accessible or where required by authority having jurisdiction.
   d. Use suitable twist-on insulated spring connectors, mechanical connectors, or compression connectors for photovoltaic circuit splices and taps.
2. Photovoltaic DC System Conductor Color Code:
   a. Positive Grounded System:
      1) Positive/Grounded: White.
      2) Negative: Black.
3. Maintain separation of photovoltaic and non-photovoltaic circuits in accordance with NFPA 70.

H. Grounding and Bonding Requirements:

1. Ensure that there is only one AC System bonding connection between grounding system and grounded/neutral conductor, including external connections and connections internal to equipment.

I. Identification Requirements:

1. Use identification nameplate or means of identification acceptable to authority having jurisdiction to identify the presence of multiple power sources and the location of main service disconnecting means and each photovoltaic system disconnecting means.

Locate at main service disconnecting means and each photovoltaic system disconnecting means. Verify format and descriptions with authority having jurisdiction.

2. Use identification nameplate to identify each photovoltaic system disconnecting means with text "PHOTOVOLTAIC SYSTEM DC DISCONNECT" or "PHOTOVOLTAIC SYSTEM AC DISCONNECT" as applicable.
3. Use identification nameplate or identification label to identify each photovoltaic system DC disconnecting means with the following information:
   a. Rated maximum power-point current (operating current).
   b. Rated maximum power-point voltage (operating voltage).
   c. Maximum system voltage.
   d. Short-circuit current.
4. Use identification nameplate or identification label to identify the interactive system point of interconnection at the disconnecting means as a power source and with the rated AC output current and the nominal operating AC voltage.
5. Use warning labels, identification nameplates, or identification labels to identify electrical hazards for photovoltaic system disconnecting means. Include the word message "Warning - Electric Shock Hazard; Do not touch terminals; Terminals on both the line and load sides may be energized in the open position" or approved equivalent.
6. Use wire and cable markers to identify photovoltaic system source, output, and inverter circuit conductors at all points of termination, connection, and splices.
7. Use voltage markers, identification labels, stenciled text, or suitable permanent marking approved by authority having jurisdiction to identify exposed raceways, cable trays, pull boxes, junction boxes, and conduit bodies with the text "Photovoltaic Power Source" at maximum intervals of 10 feet (3 m) in accordance with NFPA 70.

3.4 FIELD QUALITY CONTROL

A. See article "SYSTEM STARTUP" below for additional requirements related to testing and inspection.

B. Provide services of a manufacturer's authorized representative to observe installation and assist in inspection and testing. Include manufacturer's detailed testing procedures and field reports with submittals.

C. Inspection and testing to include, at a minimum:

1. Inspect each system component for damage and defects.
2. Verify that equipment enclosures, boxes, and associated connections installed outdoors are weatherproof.
3. Verify proper wiring connections have been made and check for conductor continuity. Verify proper polarity.
4. Verify tightness of mechanical and electrical connections is according to manufacturer's recommended torque settings.
5. Measure and record voltages at the inverter AC and DC inputs.
6. Measure and record AC output power.
7. Perform inverter functional test.
   a. Grid-Tied Inverters: Include simulation of loss of utility power and subsequent power restoration.
8. Verify proper operation of monitoring system.

D. Correct defective work, adjust for proper operation, and retest until entire system complies with contract documents.

E. Diagnostic Period: After successful completion of inspections and tests, operate system

in normal mode for at least 14 days without any system or equipment malfunctions.

1. Record all system operations and malfunctions.
2. If a malfunction occurs, start diagnostic period over after correction of malfunction.

F. Submit detailed reports indicating inspection and testing results and corrective actions taken.

G. Repair roof or adjacent roof-mounted items damaged as a result of work of this section.

3.5 SYSTEM STARTUP

A. Provide services of a manufacturer's authorized representative to assist in performing system startup. Include manufacturer's detailed startup procedures with submittals.

B. Obtain Owner's approval prior to performing system startup.

C. Grid-Tied Systems: Obtain Utility Company's approval prior to performing system startup.

D. Prepare and start system in accordance with manufacturer's instructions.

3.6 CLEANING

A. Clean modules using only methods recommended by manufacturer to avoid scratches and other damage. Clean exposed surfaces on other components to remove dirt, paint, or other foreign material and restore to match original factory finish.

3.7 CLOSEOUT ACTIVITIES

A. Demonstration: Demonstrate proper operation of system to Owner, and correct deficiencies or adjust as directed.

B. Training: Train Owner's personnel on operation, adjustment, and maintenance of photovoltaic system.

1. Use operation and maintenance manual as training reference, supplemented with additional training materials as required.
2. Provide minimum of four hours of training.

3.8 PROTECTION

A. Protect installed products from subsequent construction operations.

3.9 MAINTENANCE

A. Conduct site visit at least once every six months to perform inspection, testing, and preventative maintenance. Conduct tests similar to those made during original field quality control testing. Submit report of Owner comparing test results with those of original tests along with evaluations and recommendations.

B. Provide Trouble call-back service upon notification by Owner:

1. Include allowance for call-back service during normal working hours at no cost to Owner.

2. Owner will pay for call-back service outside of normal working hours on an hourly basis, based on actual time spent at site and not including travel time; include hourly rate and definition of normal working hours in maintenance contract.

END OF SECTION 26 32 00

Louisa May Alcott
Community School

SECTION 26 51 00 – INTERIOR AND EXTERIOR BUILDING LIGHTING

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. This section is a Division 26 General Provisions section, and is part of each Division 26, 27, and 28 sections making reference to interior and exterior building lighting.

1.2 SUMMARY

A. This section provides general requirements for a complete and fully operational lighting system including:

1. Interior and exterior building lighting fixtures, lamps, and ballasts.
2. Exit signs.
3. Accessories
4. Light fixture support

B. Extent of interior and exterior building lighting work is indicated by drawings and schedules and is specified herein.

C. Type of lighting fixtures in this section include the following:

1. Lighting Emitting Diode (LED)

D. Related Sections:

1. Section 260923 "Lighting Control Devices" for automatic control of lighting, including time switches, photoelectric relays, occupancy sensors, and multipole lighting relays and contactors.

1.3 REFERENCES

A. Conform to Reference Standards by date of issue current on date of Contract Documents, except where a specific date is established by code.

1. ANS/NFPA 70 — National Electrical Code
2. NFPA 101 — Life Safety Code
3. UL 57 — Electrical Luminaires
4. UBC Standard Section 47.1813 Luminaires
5. IES LM-79-08 — Electrical and Photometric Measurements of Solid State Lighting
6. IES LM-80 — Method for Measuring Lumen Maintenance for SSL Light Sources

B. Definitions:

1. BF: Ballast factor.

2. CCT: Correlated color temperature.
3. CRI: Color-rendering index.
4. HID: High-intensity discharge.
5. LER: Luminaire efficacy rating.
6. Lumen: Measured output of lamp and luminaire, or both.
7. Luminaire: Complete lighting fixture, including ballast housing if provided.

1.4 ACTION SUBMITTALS

A. Comply with requirements of specification section describing Submittal Procedures.

B. The authorized manufacturer's representative for the project area shall prepare submittals for each lighting fixture type. In addition to the fixture submittals, a list shall be provided identifying the manufacturer representative for each fixture type. Provide manufacturers' names, addresses, and telephone numbers. Requests for prior approval shall also include this information. Submittals or requests for prior approval without this information will be rejected.

C. Product Data shall indicate that light fixture lamps, and ballasts fully comply with contract documents. Data shall be submitted for each type of light fixture indicated, arranged in order of fixture designation. For standard catalog fixtures provide original product catalog sheets indicating data on features, accessories finishes, and the following:

1. Materials and dimensions of luminaires.
2. Photometric data, in IESNA format, based on certified results of laboratory tests complying with IESNA Lighting Measurements Testing & Calculation Guides of each lighting fixture type, outfitted with lamps,and accessories identical to those indicated for the light fixture as applied in the Project.

    a. Photometric data shall be certified by a qualified independent testing agency.
    b. Photometric data shall be certified by a manufacturer's laboratory with a current accreditation under the National Voluntary Laboratory Accreditation Program (NVLAP) for Energy Efficient Lighting Products.

3. Low voltage transformers.
4. LED power supplies.
5. Types of lamps, including manufacturer, wattage, Color Rendering index (CRI), Color Temperature in degrees Kelvin (K), color shift over life, and efficacy (lumens/watt).
6. Air and Thermal Performance Data: For air-handling light fixtures, furnish data required in "Submittals" Article in Section "Diffusers, Registers, and Grilles."
7. Sound Performance Data: For air-handling light fixtures, indicate sound power level and sound transmission class in test report certified according to standards specified in Section "Diffusers, Registers, and Grilles."

D. Shop Drawings shall:

1. Show details of nonstandard or custom fixtures.
2. Indicate dimensions, weights, methods of field assembly, components features, and accessories.
3. For custom fixtures, modified fixtures, or linear fluorescent fixtures mounted in continuous rows, submit scaled drawings prepared by the manufacturer showing all details of construction, lengths of runs, pendant and power feed locations, accessories, finished, and lists of materials.
4. Contractor to provide the manufacturer with accurate field dimensions where required.
5. Wiring diagrams, power and control wiring.

E. Wiring Diagrams shall detail wiring for fixtures and differentiate between manufacturer-installed and field-installed wiring.

F. Product samples, complete with housing, trim, specified lamp, ballast/transformer, and 8' cord with plug shall be submitted if requested.

1.5 INFORMATIONAL SUBMITTALS

A. Coordination Drawing shall include reflected ceiling plans, sections, and other details drawn to scale and coordinating the following items:

1. Light fixtures.
2. Suspended ceiling components.
3. Partitions and millwork that penetrate the ceiling or extends to within 12 inches of the plane of the luminaires.
4. Ceiling-mounted projectors.
5. Structural members to which suspension systems for light fixtures will be attached.
6. Other items in finished ceiling including the following:

    a. Air outlets and inlets
    b. Speakers
    c. Sprinklers
    d. Smoke and fire detectors
    e. Occupancy sensors
    f. Access panels

B. Product Certificates shall be signed by manufacturers of lighting fixtures certifying that products comply with requirements.

C. Maintenance Data shall be provided for lighting fixtures and equipment to include in emergency, operation, and maintenance manuals specified in specifications section describing Operations and Maintenance Data.

D. Field quality control test reports.

E. Special Warranties specified in this Section.

F. Review of luminaire submittals which indicate voltage, mounting condition, or quantities shall not be considered to be approval of said voltage, mounting condition, or quantities. Contractor shall field verify voltage and actual mounting condition and method.

1.6 SUBSTITUTIONS

A. Comply with requirements of specification section describing Product Requirements.

B. Lighting fixtures are based on the fixture types and manufacturers specified. If substitution of fixtures other than those specified is desired, product information must be submitted to the Lighting Designer/Engineer 8 days prior to the close of the bid period. No requests for substitution will be accepted after this date.

C. Substitution requests shall include all information required in paragraph 1.4 – ACTION SUBMITTALS. Requests for approval shall be accompanied by a working fixture sample (including lamps, cord, and plug). Provide the name of at least one installation where each

proposed substitute has been installed for at least six months. Provide the name and telephone number of the Architect, Owners' Representative, and Lighting Designer or Engineer of record.

D. Equipment delivery lead time shall not be held as a valid reason for requesting luminaire substitution unless luminaire lead time from specified manufacturer is in excess of twelve (12) weeks. It shall be the sole responsibility of the Contractor to determine necessary equipment lead times, deliver submittals for review in a timely fashion, and place orders accordingly to ensure timely delivery.

E. When requesting a substitution, the contractor shall provide unit and extended pricing for specified luminaire, unit and extended pricing for proposed alternate, and unit and extended savings to the Owner to be realized by accepting proposed alternate. If requested, the Contractor shall provide unit pricing for each luminaire type specified to provide a baseline comparison for substitution requests.

F. If the substitution request is accepted, approval will be in the form of an addendum to the contract documents and specifications issued to all registered plan holders.

G. A maximum of two substitution requests shall be reviewed for any single fixture type. If a substitution has not been approved following this process, the Contractor shall provide the specified fixture.

1.7 QUALITY ASSURANCE

A. Luminaire Photometric Data Testing Laboratory Qualifications: Provided by an independent agency, with the experience and capability to conduct the testing indicated, that is an NRTL as defined by OSHA in 29 CFR 1910.7.

B. Luminaire Photometric Data Testing Laboratory Qualifications: Provided by manufacturers' laboratories that are accredited under the National Volunteer Laboratory Accreditation program for Energy Efficient Lighting Products.

C. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

D. Comply with NFPA 70.

E. FM Global Compliance: Lighting fixtures for hazardous location shall be listed and labeled for indicated class and division of hazard by FM Global.

F. Luminaires, ballasts, lamps and other components and controls shall equal or exceed the requirements of all applicable state and/or municipal energy codes.

G. Designated manufacturers are listed to define the requirements for quality and function of the specified product. Equivalent or better products of other, unnamed manufacturers may be proposed for consideration by adhering to procedures set forth in this section and in Specification Section 01600 – Product Requirements.

H. Mockups: Provide interior lighting fixtures for room or module mockups, complete with power and control connections.

1. Obtain Lighting Designer's/Engineer's and Architect's approval of fixtures for mockups prior to starting installation.

2. Maintain mockups during construction in an undisturbed condition as a standard for judging the completed Work.
3. Remove mockups as directed.
4. Mockups evaluated on the project site may become part of the completed Work with the approval of the Owner, Lighting Designer/Engineer, and Architect if the mockup is undisturbed at the time of substantial completion.

I. Shop Drawings: Submit manufacturer's data on interior lighting fixtures. Submit dimensioned drawings of all lighting fixtures. Identify light fixtures by type and submit in alphabetical order.

1.8 COORDINATION

A. Coordinate layout and installation of light fixtures with ceiling system and other construction that penetrates ceilings or is supported by them including mechanical system, fire suppression, AV, and partition assemblies.

B. Provide all frames, supplementary support structures, hangers, spacers, stems aligner canopies, auxiliary junction boxes and other hardware as required for a complete and proper installation. Recessed fixtures shall have frames that are compatible with the ceiling systems.

C. Coordination Meetings: Meet with the ceiling installer to coordinate each light fixture mounting condition with ceiling type, and to coordinate fixture layouts in each area. Meet with the mechanical systems installer prior to fabrication and installation of ductwork. Coordinate depth and location of all light fixtures and ductwork in all areas.

1.9 WARRANTY

A. General Warranty: Special warranty specified in this Article shall not deprive the Owner of other rights the Owner may have under the 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. Special Warranty for LED Lighting Fixtures: A warranty must be provided by the manufacturer made out to Owner for luminaires, covering repair or replacement of defective electrical parts (including light source and power supplies) within specified warranty period indicated below.

1. Warranty Period: Five (5) years from the date the light fixtures are installed and energized.

1.10 EXTRA MATERIALS

A. Furnish extra materials described below that match product installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Glass and Plastic Lenses, Covers, Louvers, and Other Optical Parts: 10% or one dozen (whichever is less) of each type and rating installed. Furnish at least one of each type.
2. Globes and Guards: 5% of each type and rating installed. Furnish at least one of each type.

PART 2 - PRODUCTS

2.1 GENERAL

A. Provide light fixtures of types as indicated on drawings or as approved by addenda. Provide complete with, but not necessarily limited to, housings, lamps, lamp holders, reflectors, ballasts, starters, wiring, etc. Provide all light fixtures with safety latches where applicable.

B. Provide all detachable fixture parts, luminous ceiling accessories, louvers, diffusers, lenses, and reflectors with locking catches, screws, safety chains, or safety cables.

C. Provide all light fixtures and support accessories as required for a complete system.

D. Consult architectural drawings for louvers (if any) to be provided by Division 26.

2.2 MANUFACTURERS

A. Catalog numbers specified represent the full catalogue number of the fixture. The fixture size shall correspond with the wattage indicated in the Light Fixture Schedule or the actual length of the fixture as indicated on the drawings.

B. Acceptable manufacturers and full catalogue numbers are listed. The manufacturer listed shall provide complete fixtures equaling or exceeding the written specification. Verify these requirements and order fixtures as required for a complete and fully operational installation per the contract documents and per code.

2.3 GENERAL MATERIAL REQUIRMENTS

A. Fixtures shall be free of light leaks while providing sufficient ventilation of lamps to provide the required photometric performance.

B. Lamp-holders shall hold lamps securely against normal vibration and maintenance handling.

C. Light fixtures containing lamps which require protective shielding shall be furnished with a tempered glass lens or approved unbreakable lens UL listed for the application.

D. Recessed Fixtures: Comply with NEMA LE 4 for ceiling compatibility for recessed fixtures.

E. Metal Parts shall be free from burrs, sharp corners, and edges. Metal work shall be free from tool marks and dents and shall have accurate angles bent as sharply as compatible with the gauges of the required metal. Intersections and joints shall be formed true and of adequate strength and structural rigidity to prevent any distortion after assembly. All miters shall be in accurate alignment with abutting intersection members.

F. Sheet Metal Components shall be steel, unless otherwise indicated. Components shall be formed and supported to prevent warping and sagging. Luminaires to be painted after fabrication. Finish ferrous mounting hardware and accessories to prevent corrosion and discoloration to adjacent materials.

G. Fixture hardware to comply with the following material standards: For steel and aluminum fixtures, all screws, bolts, nuts and other fastening and latching hardware shall be cadmium or equivalent plated. For stainless steel fixtures, all hardware shall be stainless steel. For bronze

fixtures, all hardware shall be stainless steel or bronze.

H. Doors, Frames, and other internal access shall be smooth operating, free from light leaks under normal operating conditions, and designed to permit relamping without use of tools.

I. Provide supplemental safety device or arrange doors, frames, lenses diffusers, and other pieces to prevent accidental falling during relamping and when secured in operating position. Safety devices shall be detachable if necessary and shall not interfere with fixture performance, maintenance, or the seating of any fixture element. Safety device shall not be visible during normal fixture operation and from normal viewing angles.

J. Luminaires provided must have means for disconnection from power during service, as required in the NEC Article 410.

K. Reflecting Surfaces of light fixtures: Minimum reflectance as follows, unless otherwise indicated;

1. White Surfaces: 85%.
2. Specular Surfaces: 90%.
3. Diffusing Specular Surfaces: 75%.
4. Laminated Silver Metalized Film: 90%.

L. Reflector cones shall adhere to the following criteria:

1. Cones designed for vertically mounted lamps shall provide a minimum of 45 degree cutoff of lamp and lamp image. Cones designed for horizontally mounted lamps shall provide a minimum of 55 degree cutoff of lamp and lamp image. There shall be no visible lamp flashing in the cone.
2. Plastic material shall not be used for reflector cones, unless otherwise specified.
3. Cones shall not be permanently fastened to the housing or ceiling and shall be removable without tools. Retention devices shall not deform the cone or be visible from normal viewing angles.
4. Trim shall be flush to the finished ceiling without gaps or light leaks. Where the flange trim is separate from the cone, it shall have the same finish as the reflector cone.
5. Reflector cones shall be of uniform gauge, not less than 0.032” thick, high purity aluminum Alcoa 3002 alloy. Cones shall be free of spin marks or other defects.
6. Manufacture cone using the Alzak process. Refer to the fixture schedule for cone color and finish (i.e. specular or diffuse) requirements. For compact fluorescent fixtures, finish shall eliminate iridescence.

M. Lenses, Diffusers, Covers, and Globes shall be 100% virgin acrylic plastic or annealed crystal glass, unless otherwise indicated.

1. Plastic, polycarbonate and acrylic shall be UV stabilized and shall have high resistance to yellowing and other changes due to aging, exposure to heat and ultraviolet radiation.
2. Lens Thickness shall be a minimum of 0.125” unless other thickness is indicated.
3. Lenses shall have uniform brightness throughout the entire visible area.

N. Adjustable light fixtures shall have positive locking devices to fix the aiming angle. Fixtures shall be capable of being relamped without adjusting the aiming angle.

O. Each lighting fixture that has a lamp with an oval shape beam pattern or a spread lens that defines beam orientation shall contain lamp or lens locking devices to ensure that lamp or lens orientation is not disturbed during future lamp replacement or cleaning.

P. All fixtures and drivers must operate within the temperature limits of their design and as

specified by Underwriter' Laboratories, Inc. in the applications and mounting conditions herein specified.

Q. Factory-Applied Labels: Comply with UL 1598. Include recommended lamps and ballasts. Labels shall be located where they will be readily visible to service personnel, but not seen from normal viewing angles when lamps are in place.

1. Label shall include the following lamp and driver characteristics:

   a. "USE ONLY" and include specific lamp type.
   b. CCT and CRI for all luminaires.

R. Fixtures recessed in suspended ceilings where the space above the ceiling is either an air supply or return plenum shall conform to NEC Article 300-22.

S. Provide plaster frame for recessed light fixtures mounted in other than T-bar ceilings. Verify mounting with architectural reflected ceiling plan before ordering light fixtures.

T. Provide wire guards on all open strip type fixtures.

U. Fixtures for use in areas designated as damp locations shall be suitably gasketed to prevent the entrance of moisture. Provide approved wire mesh screens for ventilation opening. Dissimilar metals shall be separated by non-conductive material to prevent galvanic action.

V. Welding shall be done with electrodes and/or methods recommended by the manufacturers of the metals being welded. Welds shall be continuous, except where spot welding is specifically permitted. Welds exposed to view shall be ground flush and dressed smooth. All welds on or behind surfaces which will be exposed to view shall be done so that finished surface will be free of imperfections such as pits, runs, splatter, cracks warping, dimpling, depressions or other forms of distortion or discoloration. Remove weld spatter and welding oxides from all welded surfaces.

W. Electromagnetic-Interference Filters shall be factory installed to suppress conducted electromagnetic, interference as required by MIL-STD-461E.

2.6 LED FIXTURES

A. All Luminaires

1. Comply with IES LM79 and IES LM80 LED product testing procedures, and DOH energy Star requirements.
2. Luminaires shall not draw power in the off state. Luminaires with integral occupancy, motion, photo-controls, or individually addressable fixtures with external control and intelligence are exempt from this requirement. The power draw from such luminaires shall not exceed 0.5 watts when in the off state.
3. Color spatial uniformity shall be within .004 of CIE 1976 diagram.
4. Color maintenance over rated life shall be within .007 of CIE 1976.
5. Luminaires shall have a minimum CRI of 80.
6. Color shall fall within 200K of specified range.
7. LED modules shall be fully replaceable without replacing the fixture.
8. Luminaire manufacturers shall adhere to device manufacturer guidelines, certification programs, and test procedures for thermal management.
9. LED package(s)/module(s)/array(s) used in qualified luminaires shall deliver at least 70% of initial lumens, when installed in-situ, for minimum of 35,000 hours.

B. Power Supplies and Drivers

1. Power Factor 0.90 or higher
2. Operating temperature: minimum or -20ºF (129ºC) or below when used in luminaires intended for outdoor use.
3. Maximum driver case temperature not to exceed driver manufacturer recommended in-situ operation.
4. Output operating frequency: 120Hz.
5. Interference: EMI and RFI compliant with FCC 47 CFR Part 15.
6. Total Harmonic Distortion Rating: Less than 3 percent.
7. Meet electrical and thermal conditions as described in LM-80 Section 5.0.
8. Primary Current: confirm primary current with Electrical Drawings.
9. Secondary Current: Confirm secondary current specified by individual luminaire manufacturers.
10. Compatibility: Certified by manufacturer for use with individually specified luminaire and individually specified control components.
11. Solid-state control components to be integral or external per each specified luminaire. Remote control gear to be enclosed in Class 1, Class 2, or NEMA 3R enclosures as required.

C. Controller and Control System

1. System electronics driver / controller to use coordinated communication protocols: DMX512, 0-10V, DALI, or proprietary as required.
2. Contractor to ensure that external control equipment is compatible with LED control requirements.
3. Provide connector types and wiring as appropriate for un-interrupted communication between devices, considering distance maximums, field obstructions, and accessibility. Ensure that connection points are optically isolated for system noise reduction.
4. For control components that are part of overall area control system see electrical Dimming Controls specification.
5. For stand-alone controlled LED systems the Light Fixture Schedule.
6. Compatibility: certified by manufacturer for use with individually specified luminaire and individually specified power supplies and/or drivers.

2.6 EXIT SIGNS

A. General Requirements for Exit Signs: Comply with UL 924; for sign colors, visibility, luminance, and lettering size, comply with authorities having jurisdiction.

B. Internally Lighted Signs:

1. Lamps for AC Operation: LEDs, 50,000 hours minimum rated lamp life.

2.6 LAMPS

A. Lamp each fixture with the proper quantity of lamps of the type specified in the Light Fixture Schedule.

B. LED Lamps

1. See Section 2.11, LED Fixtures.

2.6 WIRING

A. All wiring shall be as required by code for fixture wiring.

B. All flexible cord wiring between fixture components or to electrical receptacles and not in wireways shall have a minimum temperature rating of 105 degrees Celsius.

C. Cords shall be fitted with proper strain reliefs and watertight entries where required by application.

D. No internal wiring shall be visible at normal viewing angles.

2.6 LIGHTING FIXTURE SUPPORT COMPONENTS

A. Comply with Section pertaining to General Electrical Provisions, paragraph entitled Equipment anchorage, Support, Seismic Restraint, and Bracing for fixture support and bracing.

B. Where the ceiling is of insufficient strength to support the weight of the lighting fixtures, provide additional framing from building structure to support luminaires as required. Do not support fixtures from ceiling T-Bar system.

C. Single-Stem Hangers shall be ½ –inch (13-mm) steel tubing with swivel ball fitting and ceiling canopy. Finish shall be the same as the luminaire.

D. Twin-Stem Hangers shall be two, ½ inch (13-mm) steel tubes with single canopy arranged to mount a single fixture. Finish shall be the same as the luminaire.

E. Rod hangers shall be 3/16-inch (5-mm) minimum diameter, cadmium-plated threaded steel rod.

F. Wires shall be ASTM A 641/A 641M, Class 3, soft temper, zinc coated steel, 12 gauge (2.68-mm).

G. Wires for humid spaces shall be ASTM A 580/A 580M, composition 302 or 304, annealed stainless steel, 12 gauge (2.68-mm).

H. Hook Hangers shall be integrated assembly matched to fixture and line voltage and equipped with threaded attachment, cord, and locking-type plug.

I. Aircraft Cable Support shall use cable anchorages, and intermediate supports recommended by fixture manufacturer.

J. Hangers for Pendant Industrial Fixtures shall be heavy duty No. 8 jack chain with hangers, “S” hooks, mounting, straps, and all required accessories for complete installation.

PART 3 - EXECUTION

3.1 GENERAL

A. Install interior light fixtures 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.

3.2 INSTALLATION

A. Fixtures: Set level, plumb, and square with ceiling and walls, and secure according to manufacturer's written instructions and approved submittal materials. Install lamps in each fixture.

B. Temporary Lighting: If it is necessary, and approved by Architect, to use permanent luminaires for temporary lighting, install and energize the minimum number of luminaires necessary. When construction is sufficiently complete, remove the temporary luminaires, disassemble, clean thoroughly, install new lamps, and reinstall.

C. Remote Mounting of Drivers: Distance between the driver and fixture shall not exceed that recommended by deriver manufacturer. Verify, with ballast manufacturers, maximum distance between ballast and luminaire.

D. Mounting height indicated in drawings from finished floor to bottom of pendant light fixture or to the center of the outlet box for all mounted light fixtures unless otherwise noted. Verify mounting heights with Architect and Lighting Designer/Engineer.

E. Mounting height may also be indicated as the length of the pendant below finished ceiling.

F. Provide all necessary hanging or mounting devices and accessories for all fixtures. Verify the types needed for various ceiling conditions. Plaster rings shall be provided where required.

G. Verify weight and mounting method of all fixtures prior to ordering and provide suitable support. Coordinate with General Contractor for fixtures that require additional blocking or support. Fixture mounting assemblies shall comply with all local seismic codes and regulations.

H. Refer to architectural reflected ceiling plans for coordination of light fixture locations with mechanical and fire safety equipment. Where conflicts occur, coordinate with Architect and Lighting Designer/Engineer prior to installing any of the systems.

I. In accessible suspended ceilings, fixture wiring connection, including equipment grounding conductor, is to be through use of 72-inch flexible conduit from a rigidly supported junction box.

J. Wire per requirements of branch circuit installation. Properly ground each fixture.

K. Connect wiring according to Section 260519 "Low-Voltage Electrical Power Conductors and Cables."

L. Light fixtures located in recessed ceilings with a fire resistive rating of 1 hour or more shall be enclosed in an approved fire resistive rated box equal to that of the ceiling.

M. Install fixtures with vent holes free of air blocking obstacles.

N. Contractor shall be responsible for adjusting aperture flanges or rings on all recessed fixtures to be flush with the finished ceiling. Fixture trim shall completely conceal ceiling opening.

O. Adjust variable position lampholders for proper lamp position prior to fixture installation.

3.3 FIXTURE SUPPORT

A. Comply with specifications section describing General Electrical Provisions, paragraph entitled Equipment anchorage, Support Seismic Restraint, and Bracing for fixture support and bracing.

B. Provide all necessary hanging or mounting devices for all fixtures, verify the type needed for various ceiling conditions. Plaster rings shall be provided where required.

C. Ceiling Fixture Support: Where ceiling is of insufficient strength to support weight of light fixtures installed, provide additional framing from building structure to support as required.

D. Lay-in Ceiling Lighting Fixtures Supports: Use grid as a support element.

1. Install ceiling support system rods or wires, independent of the ceiling suspension devices, for each fixture. Locate not more than 6 inches (150 mm) from lighting fixture corners.
2. Electrical Contractor is to provide and install locking clips for all fixtures installed in suspended ceilings that are UL listed for the application. The locking clip is to be attached to the fixture with a sheet metal screw or similar device and secured to the main or supporting T-bar runner to guarantee a secure installation. Clips shall be located at or near fixture corners.
3. Fixtures of Sizes Less Than Ceiling Grid: Install as indicated on reflected ceiling plans or center in acoustical panel, and support fixtures independently with at least two 3/4-inch (20-mm) metal channels spanning and secured to ceiling tees.
4. Install at least one independent support rod or wire from structure to a tab on lighting fixture. Wire or rod shall have breaking strength of the weight of fixture at a safety factor of 3.

E. Suspended Lighting Fixture Support:

1. Pendants and Rods: Where longer than 48 inches (1200 mm), brace to limit swinging.
2. Stem-Mounted, Single-Unit Fixtures: Suspend with twin-stem hangers.
3. Brace suspended luminaires installed near ducts or other elements so that they do not swing into obstructions.
4. Continuous Rows: Use tubing or stem for wiring at one point and tubing or rod for suspension for each unit length of fixture chassis, including one at each end.
5. Do not use grid as support for pendant luminaires. Connect support wires or rods to building structure.

F. Provide four slack No. 9 safety wire hangers or threaded rods for each recessed mounted fixture. Secure form corners of each fixture and fasten to structure above, independent of ceiling system. Locate supports not more than 6 inches from fixture corners.

G. Metal decking shall not be pierced for luminaire support.

H. Wall mounted light fixtures shall be supported from four-square outlet box plaster ring and from wall at non-feed end with two 1/4 –inch toggle bolts for gypsum board walls or 1/4 –inch bolts to pre-set inserts for concrete wall.

3.4 IDENTIFICATION

A. Install labels with panel and circuit numbers on concealed junction and outlet boxes. Comply with requirements for identification specified in Section 260553 "Identification for Electrical Systems."

3.5 LED FIXTURES

A. Adhere to manufacturer’s installation guidelines regarding proper thermal management.

3.6 LIGHTING CONTROL

A. Provide branch circuiting in coordination with lighting control requirements of specification section describing Lighting Control Equipment and as indicated on Electrical Drawings.

3.7 PROTECTION, CLEANING AND ADJUSTING

A. Protect installed and non-installed fixtures from damage during construction period.

B. Remove protective plastic covers from light fixtures and fixture diffusers only after construction work, painting and clean-up are completed. Remove, clean and reinstall all dirty lamps, reflectors and diffusers.

C. Clean fixtures internally and externally after installation. Use methods and materials recommended by manufacturer for cleaning Alzak reflectors and other surfaces.

D. Make final adjustment of aimable light fixtures and adjustable light settings under the direction of the Lighting Designer during a scheduled period of time prior to the completion of the project, after normal business hours if required. Include all equipment and personnel expenses including overtime required for focusing.

E. Fixtures, reflectors, and accessories which are damaged, blemished or impregnated with fingerprints shall be replaced at the contractor's expense. All finishes shall be unmarred upon project completion.

3.8 FIELD QUALITY CONTROL

A. Coordinate all testing procedures and schedule with the specification section describing Commissioning Agent – Demonstration and Training. All testing is to be documented with test procedures, results and initials of witnessing personnel and submitted to Commissioning Agent.

B. Coordinate inspection and testing of Light Fixtures with specification section describing – Lighting Control Equipment.

C. Inspect each installed fixture for damage. Replace damaged fixtures and components.

D. Replace all burned out lamps or inoperative lamps at the end of construction prior to Owner occupancy.

E. Advance Notice: Give dates and times for field tests.

F. Provide instruments to make and record test results.

G. Test as follows:

1. Verify proper operation, switching and phasing of each fixture after installation.
2. Emergency Lighting: Interrupt electrical supply to demonstrate proper operation. Verify normal transfer to generator and retransfer to normal.
3. Prepare a written report of tests, inspections, observations, and verifications indicating and interpreting results. If adjustments are made to the lighting system, retest to demonstrate compliance with standards.

H. Malfunctioning Fixtures and Components: Replace or repair, then retest. Repeat procedure until unit operates properly.

3.9 SPARE PARTS

A. Acrylic Diffusers: Provide a spare acrylic diffusers and/or glass for each light fixture type and one for each additional unit for each 10 fixtures. The quantity of any single type need not exceed 10.

END OF SECTION 26 51 00

SECTION 26 52 00 – EXTERIOR AREA LIGHTING

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. This section is a Division 26 General Provisions section, and is part of each Division 26, 27, and 28 sections making reference to exterior area lighting.

1.2 DESCRIPTION OF WORK:

A. Extent of exterior area lighting work is indicated by drawings and schedules and is specified herein.

1.3 QUALITY ASSURANCE:

A. STANDARDS: Refer to Section 260001 - Electrical General Provisions and other sections as applicable.

B. SHOP DRAWINGS: Submit manufacturer's data on exterior area lighting items including but not necessarily limited to poles, brackets, light fixtures, fuse, fuseblocks, etc. Submit dimensioned drawings of all pole and lighting fixtures. Include information with interior and exterior building lighting fixtures.

PART 2 – PRODUCTS

2.1 GENERAL:

A. Provide exterior lighting fixtures of types as indicated on drawings or as approved by addenda.

2.2 LIGHT FIXTURES:

A. Refer to Section 265100 - Interior and Exterior Building Lighting for requirements for exterior light fixtures, lamps, ballasts, etc.

2.3 POLES:

A. Provide poles and all accessories including but not necessarily limited to anchor bolts, templates for anchor bolt pattern, brackets, bolts, etc. Provide handhole and cover at base of each pole. Provide poles which have been primed and painted at the factory. Provide poles, anchor bolts, etc. in sizes as recommended by manufacturer to withstand windloadings.

2.4 CONCRETE BASES:

A. Provide 5000 psi class concrete, forms, steel reinforcement, tie wires, etc. as required. See drawings for details.

2.5 GROUND RODS:

A. See Section 260452 – Grounding for ground rod requirements.

2.6 FUSEHOLDER, FUSES, AND BREAK-A-WAY RECEPTACLES:

A. Provide fuseholders with break-a-way receptacles equivalent to Bussmann Tron Waterproof Fuseholders and Break-A-Way Receptacles in the base for all phase conductors and materials. Neutral fuse holder will use a shorting fuse insert. Provide Bussmann KTK-R fuses in ratings to suit respective applications and sized in accordance with all manufacturer's recommendations.

PART 3 – EXECUTION

3.1 GENERAL:

A. Install exterior area lighting 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.

3.2 INSTALLATION METHODS:

A. Set all poles plumb. Use belt slings or ropes to raise and set poles to protect finish. Repair nicks and scratches to match original surface.

B. Locate fuseholder at handhole. Provide fuse blanks in all neutral conductors.

C. Grounding: Provide one ground rod for each light pole. Connect ground rod to pole by means of an NEC-sized grounding conductor and all additional grounding as required.

3.3 CONCRETE BASES:

A. Provide concrete bases for light poles in accordance with details on drawings. Grout and hand-rub all concrete to a uniform smooth finish.

3.4 SPARE PARTS:

A. FUSES: Provide three spare fuses for each type and size used.

3.5 WIRING METHODS:

A. No common neutral multi-wire circuits will be used to feed area lighting. Provide dedicated neutral wire for each circuit indicated.

END OF SECTION 26 52 00

SECTION 27 05 26 – 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. EMT: Electrical metallic tubing.

C. TGB: Telecommunications grounding busbar.

D. TMGB: Telecommunications main grounding busbar.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Shop Drawings: For communications equipment room signal reference grid. Include plans, elevations, sections, details, and attachments to other work.

1.5 INFORMATIONAL SUBMITTALS

A. As-Built Data: Plans showing as-built locations of grounding and bonding infrastructure, including the following:

1. Ground and roof rings.
2. BCT, TMGB, TGBs, and routing of their bonding conductors.

B. Qualification Data: For Installer, installation supervisor, and field inspector.

C. Qualification Data: For testing agency and testing agency's field supervisor.

D. 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 Installer 2, 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 registered communications distribution designer to perform the on-site inspection.

PART 2 - PRODUCTS

2.1 SYSTEM COMPONENTS

A. Comply with J-STD-607-A.

2.2 CONDUCTORS

A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1. Harger Lightning and Grounding.
2. Panduit Corp.
3. Tyco Electronics Corp.

B. Comply with UL 486A-486B.

C. 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.

D. Cable Tray Grounding Jumper:

1. Not smaller than No. 6 AWG [26 kcmils (13.3 sq. mm)] and not longer than 12 inches (300 mm). 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.

E. 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 (14.2 sq. mm), 14 strands of No. 17 AWG conductor, and 1/4 inch (6.3 mm) 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 (41 mm) wide and 1/16 inch (1.6 mm) 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. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1. Burndy; Part of Hubbell Electrical Systems.
2. Chatsworth Products, Inc.
3. Harger Lightning and Grounding.
4. Panduit Corp.
5. Tyco Electronics Corp.

C. 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.

D. Busbar Connectors: Cast silicon bronze, solderless compression or exothermic-type, mechanical connector; with a long barrel and two holes spaced on 5/8- or 1-inch (15.8- or 25.4-mm) 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, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1. Chatsworth Products, Inc.
2. Harger Lightning and Grounding.
3. Panduit Corp.

B. TMGB: Predrilled, wall-mounted, rectangular bars of hard-drawn solid copper, [1/4 by 4 inches (6.3 by 100 mm)] in cross section, length as indicated on Drawings. The busbar shall be NRTL listed for use as TMGB and shall comply with J-STD-607-A.

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 (100-mm)] 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.

C. TGB: Predrilled rectangular bars of hard-drawn solid copper, [1/4 by 2 inches (6.3 by 50 mm)] 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 J-STD-607-A.

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 2-inch (50-mm 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.

D. Rack and Cabinet Grounding Busbars: Rectangular bars of hard-drawn solid copper, accepting conductors ranging from No. 14 to No. 2/0 AWG, NRTL listed as complying with UL 467, and complying with J-STD-607-A. Predrilling shall be with holes for use with lugs specified in this Section.

1. Cabinet-Mounted Busbar: Terminal block, with stainless-steel or copper-plated hardware for attachment to the cabinet.
2. Rack-Mounted Horizontal Busbar: Designed for mounting in 19- or 23-inch (483- or 584-mm) equipment racks. Include a copper splice bar for transitioning to an adjoining rack, and stainless-steel or copper-plated hardware for attachment to the rack.
3. Rack-Mounted Vertical Busbar: 72 or 36 inches (1827 or 914 mm long, with) stainless-steel or copper-plated hardware for attachment to the rack.

2.5 LABELING

A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1. Brother International Corporation.
2. HellermannTyton.
3. Panduit Corp.

B. Comply with TIA/EIA-606-A and UL 969 for a system of labeling materials, including label stocks, laminating adhesives, and inks used by label printers.

C. Adhesive Film Label with Clear Protective Overlay: Machine printed, in black, by thermal transfer or equivalent process. Minimum letter height shall be 3/8 inch (10 mm). Overlay shall provide a weatherproof and UV-resistant seal for label.

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 J-STD-607-A.

3.3 APPLICATION

A. Conductors: Install solid conductor for No. 10 AWG and smaller and stranded conductors for No. 8 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. 3/0 AWG.
2. The bonding conductors between the TMGB and structural steel of steel-frame buildings shall not be smaller than No. 3/0 AWG.

B. Conductor Terminations and Connections:

1. Pipe and Equipment Grounding Conductor Terminations: Bolted connectors.
2. Connections to Structural Steel: Welded connectors.

C. Conductor Support:

1. Secure grounding and bonding conductors at intervals of not less than 36 inches (900 mm.)

D. 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 (900-mm) intervals.
4. Install grounding and bonding conductors in PVC conduit sized in accordance with the NEC 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 and bond both ends of the conduit to a TGB.

3.4 GROUNDING ELECTRODE SYSTEM

A. The BCT between the TMBG 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 2 inches (50 mm) minimum from wall, 12 inches (300 mm) above finished floor unless otherwise indicated.

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. Interconnections: Interconnect all TGBs with the TMGB with the telecommunications backbone conductor. If more than one TMGB is installed, interconnect TMGBs using the grounding equalizer conductor. The telecommunications backbone conductor and grounding equalizer conductor size shall not be less than 2 kcmils/linear foot (1 sq. mm/linear meter) of conductor length, up to a maximum size of No. 3/0 AWG [168 kcmils (85 sq. mm)] unless otherwise indicated.

F. Telecommunications Enclosures and Equipment Racks: Bond metallic components of enclosures to the telecommunications bonding and grounding system. Install top-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.

G. 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.

H. Shielded Cable: Bond the shield of shielded cable to the TGB in communications rooms and spaces. Comply with TIA/EIA-568-B.1 and TIA/EIA-568-B.2 when grounding screened, 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.

J. Electronic System Equipment: Bond equipment chassis of other electronic system equipment including fire alarm, intrusion detection, access control, and educational school intercom and program systems to the TGB or TMGB located in their respective communication rooms.

3.7 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!"

3.8 FIELD QUALITY CONTROL

A. Testing Agency: Engage a qualified testing agency to perform tests and inspections.

B. Perform tests and inspections.

C. 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.

D. Excessive Ground Resistance: If resistance to ground at the BCT exceeds 5 ohms, notify Architect promptly and include recommendations to reduce ground resistance.

E. Grounding system will be considered defective if it does not pass tests and inspections.

F. Prepare test and inspection reports.

END OF SECTION 27 0526

SECTION 27 11 00 – COMMUNICATIONS EQUIPMENT ROOM FITTINGS

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. Telecommunications mounting elements.
2. Backboards.
3. Telecommunications equipment racks and cabinets.
4. Grounding.

B. Related Requirements:

1. Section 26 0536 "Cable Trays" for cable trays and accessories.
2. Section 271300 "Communications Backbone Cabling" for voice and data cabling associated with system panels and devices.
3. Section 271500 "Communications Horizontal Cabling" for voice and data cabling associated with system panels and devices.

1.3 DEFINITIONS

A. BICSI: Building Industry Consulting Service International.

B. LAN: Local area network.

C. RCDD: Registered Communications Distribution Designer.

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 equipment racks and cabinets.
2. Include rated capacities, operating characteristics, electrical characteristics, and furnished specialties and accessories.

B. Shop Drawings: For communications equipment room fittings. Include plans, elevations, sections, details, and attachments to other work.

1. Detail equipment assemblies and indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.

2. Equipment Racks and Cabinets: Include workspace requirements and access for cable connections.
3. Grounding: Indicate location of grounding bus bar and its mounting detail showing standoff insulators and wall mounting brackets.

1.5 INFORMATIONAL SUBMITTALS

A. Qualification Data: For Installer, qualified layout technician, installation supervisor, and field inspector.

B. Seismic Qualification Certificates: For equipment frames from manufacturer.

1. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.
2. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions. Base certification on the maximum number of components capable of being mounted in each rack type. Identify components on which certification is based.
3. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.

1.6 QUALITY ASSURANCE

A. Installer Qualifications: Cabling Installer must have personnel certified by BICSI on staff.

1. Layout Responsibility: Preparation of Shop Drawings shall be under the direct supervision of RCDD.
2. Installation Supervision: Installation shall be under the direct supervision of Level 2 Installer, who shall be present at all times when Work of this Section is performed at Project site.
3. Field Inspector: Currently registered by BICSI as RCDD to perform the on-site inspection.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Seismic Performance: Equipment frames shall withstand the effects of earthquake motions determined according to ASCE/SEI 7.

1. The term "withstand" means "the unit will remain in place without separation of any parts from the device when subjected to the seismic forces specified and the unit will be fully operational after the seismic event."

2.2 BACKBOARDS

A. Backboards: Plywood, fire-retardant treated, 3/4 by 48 by 96 inches (19 by 1220 by 2440 mm). Comply with requirements for plywood backing panels specified in Section 061000 "Rough Carpentry."

2.3 EQUIPMENT FRAMES

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. ADC.
2. Belden Inc.
3. Cooper B-Line.
4. Emerson Network Power Connectivity Solutions.
5. Hubbell Premise Wiring.
6. Leviton Commercial Networks Division.
7. Middle Atlantic Products, Inc.
8. Ortronics, Inc.
9. Panduit Corp.
10. Siemon Co. (The).
11. Tyco Electronics Corporation; AMP Products.

B. General Frame Requirements:

1. Distribution Frames: Freestanding, 2-post, modular-steel units designed for telecommunications terminal support and coordinated with dimensions of units to be supported.
2. Module Dimension: Width compatible with EIA 310-D standard, 19-inch (480-mm) panel mounting.
3. Finish: Manufacturer's standard, baked-polyester powder coat.

C. Floor-Mounted Racks: Modular-type, steel construction.

1. Vertical and horizontal cable management channels, top and bottom cable troughs, and grounding lug.
2. Baked-polyester powder coat finish.

D. Cable Management for Equipment Frames:

1. Vertical Cable Management: Metal or plastic, 6” wide channel, front and back of each rack, with hinged cover. Metal if utilized shall be baked-polyester powder coat finish.
2. Horizontal Cable Management: Plastic with a minimum height of two rack units each, cover, end caps, front and back of each rack.

2.4 GROUNDING

A. Comply with requirements in Section 270526 "Grounding and Bonding for Communication Systems" for grounding conductors and connectors.

B. Telecommunications Main Bus Bar:

1. Connectors: Mechanical type, cast silicon bronze, solderless compression-type wire terminals, and long-barrel, two-bolt connection to ground bus bar.
2. Ground Bus Bar: Copper, minimum 1/4-inch-thick by 4 inches wide (6 mm thick by 100 mm wide) with 9/32-inch (7.14-mm) holes spaced 1-1/8 inches (28 mm) apart.
3. Stand-Off Insulators: Comply with UL 891 for use in switchboards, 600 V. Lexan or PVC, impulse tested at 5000 V.

C. Comply with J-STD-607-A.

2.5 LABELING

A. Comply with TIA/EIA-606-A and UL 969 for a system of labeling materials, including label stocks, laminating adhesives, and inks used by label printers.

PART 3 - EXECUTION

3.1 ENTRANCE FACILITIES

A. Contact telecommunications service provider and arrange for installation of demarcation point, protected entrance terminals, and a housing when so directed by service provider.

3.2 PRE-CONSTRUCTION MEETING: Attend a Pre-Construction Meeting with the Owner to review installation standards and to discuss layout of racking and equipment prior to doing any work.

3.3 INSTALLATION

A. Comply with NECA 1.

B. Comply with BICSI TDMM for layout and installation of communications equipment rooms.

C. Bundle, lace, and train conductors and cables to terminal points without exceeding manufacturer's limitations on bending radii. Install lacing bars and distribution spools.

D. Coordinate layout and installation of communications equipment with the Owner IT Department and the Owner's telecommunications and LAN equipment and service suppliers. Coordinate service entrance arrangement with local exchange carrier.

1. Meet jointly with the Owner IT Department, telecommunications and LAN equipment suppliers, local exchange carrier representatives, and Owner to exchange information and agree on details of equipment arrangements and installation interfaces.
2. Record agreements reached in meetings and distribute them to other participants.
3. Adjust arrangements and locations of distribution frames, cross-connects, and patch panels in equipment rooms to accommodate and optimize arrangement and space requirements of telephone switch and LAN equipment.
4. Adjust arrangements and locations of equipment with distribution frames, cross-connects, and patch panels of cabling systems of other communications, electronic safety and security, and related systems that share space in the equipment room.

E. Coordinate location of power raceways and receptacles with locations of communications equipment requiring electrical power to operate.

F. Seismically brace floor-mounted racks with C-channel supports extending from each rack to the wall. Refer to Section 260072, “Electrical Supports and Seismic Restraints”.

3.4 FIRESTOPPING

A. Comply with requirements in Section 078413 "Penetration Firestopping."

B. Comply with TIA-569-B, Annex A, "Firestopping."

C. Comply with BICSI TDMM, "Firestopping Systems" Article.

3.5 GROUNDING

A. Install grounding according to BICSI TDMM, "Grounding, Bonding, and Electrical Protection" Chapter.

B. Comply with J-STD-607-A.

C. Locate grounding bus bar to minimize the length of bonding conductors. Fasten to wall allowing at least 2-inch (50-mm) clearance behind the grounding bus bar. Connect grounding bus bar with a minimum No. 4 AWG grounding electrode conductor from grounding bus bar to suitable electrical building ground.

D. Bond metallic equipment to the grounding bus bar, using not smaller than No. 6 AWG equipment grounding conductor.

1. Bond the shield of shielded cable to the grounding bus bar in communications rooms and spaces.

3.6 IDENTIFICATION

A. Identify system components, wiring, and cabling complying with TIA/EIA-606-A.

B. Comply with requirements in Section 099123 "Interior Painting" for painting backboards. For fire-resistant plywood, do not paint over manufacturer's label.

C. Paint and label colors for equipment identification shall comply with TIA/EIA-606-A for Class 2 level of administration including optional identification requirements of this standard.

D. Labels shall be preprinted or computer-printed type.

END OF SECTION 27 11 00

SECTION 27 13 00 – COMMUNICATIONS BACKBONE CABLING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Pathways.
2. UTP cable.
3. 8.3/125-micrometer, optical fiber cabling.
4. Cable connecting hardware, patch panels, and cross-connects.
5. Cabling identification products.

B. Related Sections:

1. Section 271500 "Communications Horizontal Cabling" for voice and data cabling associated with system panels and devices.

1.3 DEFINITIONS

A. BICSI: Building Industry Consulting Service International.

B. Cross-Connect: A facility enabling the termination of cable elements and their interconnection or cross-connection.

C. EMI: Electromagnetic interference.

D. IDC: Insulation displacement connector.

E. LAN: Local area network.

F. RCDD: Registered Communications Distribution Designer.

G. UTP: Unshielded twisted pair.

1.4 BACKBONE CABLING DESCRIPTION

A. Backbone cabling system shall provide interconnections between communications equipment rooms, main terminal space, and entrance facilities in the telecommunications cabling system structure. Cabling system consists of backbone cables, intermediate and main cross-connects, mechanical terminations, and patch cords or jumpers used for backbone-to-backbone cross-connection.

B. Backbone cabling cross-connects may be located in communications equipment rooms or at entrance facilities. Bridged taps and splitters shall not be used as part of backbone cabling.

C. TOPOLOGY: Each telecommunications closet (IDF) shall be wired to the main cross-connect (MDF). Bridged taps, which create multiple appearances of the same cable at several distribution points, are not acceptable. There is a limitation of two hierarchical levels of backbone cross-connects, so that so that interconnections between any two telecommunications closets must not pass through more than three cross connect facilities.

1.5 PERFORMANCE REQUIREMENTS

A. General Performance: Backbone cabling system shall comply with transmission standards in TIA/EIA-568-B.1, when tested according to test procedures of this standard.

1.6 ACTION SUBMITTALS

A. Product Data: For each type of product indicated.

B. Shop Drawings:

1. System Labeling Schedules: Electronic copy of labeling schedules, in software and format selected by Owner.
2. Cabling administration drawings and printouts.
3. Wiring diagrams to show typical wiring schematics including the following:

    a. Cross-connects.
    b. Patch panels.
    c. Patch cords.

4. Cross-connects and patch panels. Detail mounting assemblies, and show elevations and physical relationship between the installed components.

1.7 INFORMATIONAL SUBMITTALS

A. Qualification Data: For Installer, qualified layout technician, installation supervisor, and field inspector.

B. Source quality-control reports.

C. Field quality-control reports.

D. Maintenance Data: For splices and connectors to include in maintenance manuals.

1.8 CLOSEOUT SUBMITTALS

A. Software and Firmware Operational Documentation:

1. Software operating and upgrade manuals.
2. Program Software Backup: On magnetic media or compact disk, complete with data files.
3. Device address list.

4. Printout of software application and graphic screens.

B. Warranty documentation:

1. Include copy of final, executed warranties.
2. Contact information.

C. Data map.

D. Test results.

1.9 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. Patch-Panel Units: One of each type.
2. Connecting Blocks: One of each type.

1.10 QUALITY ASSURANCE

A. Installer Qualifications: Cabling Installer must have personnel certified by BICSI on staff.

1. Layout Responsibility: Preparation of Shop Drawings, Cabling Administration Drawings, and field testing program development by an RCDD.
2. Installation Supervision: Installation shall be under the direct supervision of Level 2 Installer (copper and optical fiber), who shall be present at all times when Work of this Section is performed at Project site.
3. Testing Supervisor: Currently certified by BICSI as an RCDD to supervise on-site testing.

B. Testing Agency Qualifications: An NRTL.

1. Testing Agency's Field Supervisor: Currently certified by BICSI as an RCDD to supervise on-site testing.

C. Surface-Burning Characteristics: As determined by testing identical products according to ASTM E 84 by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.

1. Flame-Spread Index: 25 or less.
2. Smoke-Developed Index: 450 or less.

D. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

E. Telecommunications Pathways and Spaces: Comply with TIA/EIA-569-A.

F. Grounding: Comply with ANSI-J-STD-607-A.

1.11 DELIVERY, STORAGE, AND HANDLING

A. Test cables upon receipt at Project site.

1. Test optical fiber cable to determine the continuity of the strand end to end. Use optical loss test set.
2. Test optical fiber cable while on reels. Use an optical time domain reflectometer to verify the cable length and locate cable defects, splices, and connector, including the loss value of each. Retain test data and include the record in maintenance data.
3. Test each pair of UTP cable for open and short circuits.

1.12 PROJECT CONDITIONS

A. Environmental Limitations: Do not deliver or install cables and connecting materials until wet work in spaces is complete and dry, and temporary HVAC system is operating and maintaining ambient temperature and humidity conditions at occupancy levels during the remainder of the construction period.

1.13 COORDINATION

A. Coordinate layout and installation of telecommunications pathways and cabling with Owner's telecommunications and LAN equipment and service suppliers.

1.14 WARRANTY

A. The system shall provide a 20-year warranty for applications, parts, and labor.

PART 2 - PRODUCTS

2.1 PATHWAYS

A. General Requirements: Comply with TIA/EIA-569-A.

B. Cable Support: NRTL labeled for support of Category 6 cabling, designed to prevent degradation of cable performance and pinch points that could damage cable.

1. Support brackets with cable tie slots for fastening cable ties to brackets.
2. Lacing bars, spools, J-hooks, and D-rings.
3. Straps and other devices.

C. Cable Trays: Refer to section 260111, “Cable Trays”.

D. Conduit and Boxes: Comply with requirements in Section 260135 "Electrical Boxes and Fittings."

1. Outlet boxes shall be no smaller than 2 inches (50 mm) wide, 3 inches (75 mm) high, and 2-1/2 inches (64 mm) deep.
2. Flexible metal conduit shall not be used.

2.2 BACKBOARDS

A. Backboards: Plywood, fire-retardant treated, 3/4 by 48 by 96 inches (19 by 1220 by 2440 mm). Comply with requirements in Section 061000 "Rough Carpentry" for plywood backing panels.

2.3 UTP CABLE

A. Basis of Design Product: Subject to compliance with requirements, provide Mohawk GigaLAN 10 Augmented Cat 6A UTP or comparable product by one of the following:

1. Hitachi Cable America, Inc
2. Optical Cable Corporation
3. Superior Essex Inc.
4. Tyco Electronics/AMP Netconnect; Tyco International Ltd.

B. Description: 100-ohm, four pair UTP, covered with a thermoplastic jacket.

1. Comply with ICEA S-90-661 for mechanical properties.
2. Comply with TIA/EIA-568-B.1 for performance specifications.
3. Comply with TIA/EIA-568-B.2, Category 6A.
4. Listed and labeled by an NRTL acceptable to authorities having jurisdiction as complying with UL 444 and NFPA 70 for the following types:

   a. Communications, Plenum Rated: Type CMP, complying with NFPA 262.
   b. Communications, Riser Rated: Type CMR, complying with UL 1666.

5. Jacket colors:

   a. Wireless Access Points: White.
   b. School Intercom: Orange.
   c. CCTV: Purple.
   d. Data: Blue.
   e. Energy: Green.

2.4 UTP CABLE HARDWARE

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Leviton Voice & Data Division.
2. Tyco Electronics/AMP Netconnect; Tyco International Ltd.

B. General Requirements for Cable Connecting Hardware: Comply with TIA/EIA-568-B.2, IDC type, with modules designed for punch-down caps or tools. Cable shall be terminated with connecting hardware of same category or higher.

C. Patch Panel: Modular panels housing multiple-numbered jack units with IDC-type connectors at each jack for permanent termination of pair groups of installed cables.

1. Number of Jacks per Field: One for each four-pair UTP cable indicated.

D. Jacks and Jack Assemblies: Modular, color-coded, eight-position modular receptacle units with integral IDC-type terminals.

E. Patch Cords: Provide factory-made, 4-pair cables. 80% of the patch cords shall be 36-inch (914-mm) and the remaining 20% shall be 60-inch (1524-mm) for each patch panel to patch panel connection; terminated with 8-position modular plug at each end. 120-inch (3048-mm) patch cords shall be provided at desk-top (user) locations.

1. Patch cords shall have bend-relief-compliant boots and color-coded icons to ensure Category 6A performance. Patch cords shall have latch guards to protect against snagging.
2. Patch cords shall be color-coded to match color of system for circuit identification.

2.5 OPTICAL FIBER CABLE

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Berk-Tek; a Nexans company.
2. CommScope, Inc.
3. Corning Cable Systems.
4. General Cable Technologies Corporation.
5. Mohawk; a division of Belden CDT.
6. Nordex/CDT; a subsidiary of Cable Design Technologies.
7. Optical Cable Corporation.
8. Optical Connectivity Solutions Division; Emerson Network Power.
9. Superior Essex Inc.
10. SYSTIMAX Solutions; a CommScope Inc. brand.
11. 3M.
12. Tyco Electronics/AMP Netconnect; Tyco International Ltd.

B. Description: Single mode, 8.3/125-micrometer, 12-fiber, nonconductive, tight buffer, optical fiber cable, for 10 GIG operation.

1. Comply with ICEA S-83-596 for mechanical properties.
2. Comply with TIA/EIA-568-B.3 for performance specifications.
3. Comply with TIA/EIA-492-CAAA for detailed specifications.
4. Listed and labeled by an NRTL acceptable to authorities having jurisdiction as complying with UL 444, UL 1651, and NFPA 70 for the following types:

   a. Plenum Rated, Nonconductive: Type OFNP, complying with NFPA 262.
   b. Riser Rated, Nonconductive: Type OFNR, complying with UL 1666.

5. Maximum Attenuation: 0.65/0.5 db/km at 1310/21550 nm.

C. Jacket:

1. Jacket Color: Yellow for 8.3/125-Micromeser Cable.
2. Cable cordage jacket, fiber, unit, and group color shall be according to TIA/EIA-598-B.
3. Imprinted with fiber count, fiber type, and aggregate length at regular intervals not to exceed 40 inches (1000 mm).

D. Underground Applications:

1. Must be specifically approved for use by the Owner.
2. Cables shall be moisture tolerant in a method approved by the Owner.

2.6 OPTICAL FIBER CABLE HARDWARE

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. ADC.
2. American Technology Systems Industries, Inc.
3. Berk-Tek; a Nexans company.
4. Corning Cable Systems.
5. Dynacom Corporation.
6. Hubbell Premise Wiring.
7. Molex Premise Networks; a division of Molex, Inc.
8. Nordex/CDT; a subsidiary of Cable Design Technologies.
9. Optical Cable Corporation.
10. Optical Connectivity Solutions Division; Emerson Network Power.
11. Siemon Co. (The).

B. Light Guide Interface Unit (LIU): Rack-mounted modular enclosure with fan-out assemblies that provides cross-connect and interconnect capabilities for terminating fiber optic building cables and each end. All termination shall be TIA/EIA-568SC type as specified in the SP-2840A Standards. Provide LC connectors only for terminations.

C. Patch Cords: Factory-made, dual-fiber cables in 72-inch (1800-mm) lengths for connections between owner-provided HUB to LIU.

D. Cable Connecting Hardware:

1. Comply with Optical Fiber Connector Intermateability Standards (FOCIS) specifications of TIA/EIA-604-2, TIA/EIA-604-3-A, and TIA/EIA-604-12. Comply with TIA/EIA-568-B.3.
2. Quick-connect, simplex and duplex, Type LC connectors. Insertion loss not more than 0.75 dB.

2.7 GROUNDING

A. Comply with requirements in Section 270526 "Grounding and Bonding for Communication Systems" for grounding conductors and connectors.

B. Comply with ANSI-J-STD-607-A.

2.8 IDENTIFICATION PRODUCTS

A. Comply with TIA/EIA-606-A and UL 969 for a system of labeling materials, including label stocks, laminating adhesives, and inks used by label printers.

2.9 SOURCE QUALITY CONTROL

A. Testing Agency: Engage a qualified testing agency to evaluate cables.

B. Factory test cables on reels according to TIA/EIA-568-B.1.

C. Factory test UTP cables according to TIA/EIA-568-B.2.

D. Cable will be considered defective if it does not pass tests and inspections.

E. Prepare test and inspection reports.

PART 3 - EXECUTION

3.1 ENTRANCE FACILITIES

A. Coordinate backbone cabling with the protectors and demarcation point provided by communications service provider.

3.2 PRE-CONSTRUCTION MEETING: Attend a Pre-Construction Meeting with the Owner to review installation standards prior to doing any work.

3.3 WIRING METHODS

A. Wiring Method: Install cables in raceways except within consoles, cabinets, desks, and counters. Conceal raceway and cables except in unfinished spaces.

1. Install plenum cable in environmental air spaces, including plenum ceilings.
2. Comply with requirements for raceways and boxes specified in Section 260135 "Electrical Boxes and Fittings."

B. Wiring within Enclosures: Bundle, lace, and train cables within enclosures. Connect to terminal points with no excess and without exceeding manufacturer's limitations on bending radii. Provide and use lacing bars and distribution spools.

3.4 INSTALLATION OF PATHWAYS

C. Coordinate cable connection hardware installations and specialty arrangements with layout drawings and with requirements specified for communications equipment rooms. If Drawings are explicit enough, these requirements may be reduced or omitted.

D. Comply with requirements for demarcation point, pathways, cabinets, and racks specified in Section 271100 "Communications Equipment Room Fittings." Drawings indicate general arrangement of pathways and fittings.

E. Comply with TIA/EIA-569-A for pull-box sizing and length of conduit and number of bends between pull points.

F. Comply with requirements in Section 260135 "Electrical Boxes and Fittings" for installation of conduits and wire ways.

G. Install manufactured conduit sweeps and long-radius elbows whenever possible.

H. Pathway Installation in Communications Equipment Rooms:

1. Position conduit ends adjacent to a corner on backboard where a single piece of plywood is installed, or in the corner of room where multiple sheets of plywood are installed around perimeter walls of room.

2. Install cable trays to route cables if conduits cannot be located in these positions.
3. Secure conduits to backboard when entering room from overhead.
4. Extend conduits 3 inches (76 mm)] above finished floor.
5. Install metal conduits with grounding bushings and connect with grounding conductor to grounding system.

I. Backboards: Install backboards with 96-inch (2440-mm) dimension vertical. Butt adjacent sheets tightly, and form smooth gap-free corners and joints.

3.5 INSTALLATION OF CABLES

A. Comply with NECA 1.

B. General Requirements for Cabling:

1. Comply with TIA/EIA-568-B.1.
2. Comply with BICSI ITSIM, Ch. 6, "Cable Termination Practices."
3. Make terminations only at indicated outlets, terminals, cross-connects, and patch panels.
4. Cables may not be spliced. Secure and support cables at intervals not exceeding 30 inches (760 mm) and not more than 6 inches (150 mm) from cabinets, boxes, fittings, outlets, racks, frames, and terminals.
5. Install lacing bars to restrain cables, to prevent straining connections, and to prevent bending cables to smaller radii than minimums recommended by manufacturer.
6. Bundle, lace, and train conductors to terminal points without exceeding manufacturer's limitations on bending radii, but not less than radii specified in BICSI ITSIM, "Cabling Termination Practices" Chapter. Use lacing bars and distribution spools.
7. Do not install bruised, kinked, scored, deformed, or abraded cable. Do not splice cable between termination, tap, or junction points. Remove and discard cable if damaged during installation and replace it with new cable.
8. Cold-Weather Installation: Bring cable to room temperature before dereeling. Heat lamps shall not be used for heating.
9. In the communications equipment room, install a 10-foot- (3-m-) long service loop on each end of cable.
10. Pulling Cable: Comply with BICSI ITSIM, Ch. 4, "Pulling Cable." Monitor cable pull tensions.

C. UTP Cable Installation:

1. Comply with TIA/EIA-568-B.2.
2. Do not untwist UTP cables more than 1/2 inch (12 mm) from the point of termination to maintain cable geometry.

D. Optical Fiber Cable Installation:

1. Comply with TIA/EIA-568-B.3.
2. Cable may be terminated on connecting hardware that is rack or cabinet mounted.

E. Open-Cable Installation:

1. Install cabling with horizontal and vertical cable guides in telecommunications spaces with terminating hardware and interconnection equipment.
2. Suspend UTP cable not in a wireway or pathway, a minimum of 8 inches (200 mm) above ceilings by cable supports not more than 60 inches (1524 mm) apart.

3. Cable shall not be run through structural members or in contact with pipes, ducts, or other potentially damaging items.

F. Group connecting hardware for cables into separate logical fields.

G. Separation from EMI Sources:

1. Comply with BICSI TDMM and TIA/EIA-569-A recommendations for separating unshielded copper voice and data communication cable from potential EMI sources, including electrical power lines and equipment.
2. Separation between open communications cables or cables in nonmetallic raceways and unshielded power conductors and electrical equipment shall be as follows:

   a. Electrical Equipment Rating Less Than 2 kVA: A minimum of 5 inches (127 mm).
   b. Electrical Equipment Rating between 2 and 5 kVA: A minimum of 12 inches (300 mm).
   c. Electrical Equipment Rating More Than 5 kVA: A minimum of 24 inches (610 mm).

3. Separation between communications cables in grounded metallic raceways and unshielded power lines or electrical equipment shall be as follows:

   a. Electrical Equipment Rating Less Than 2 kVA: A minimum of 2-1/2 inches (64 mm).
   b. Electrical Equipment Rating between 2 and 5 kVA: A minimum of 6 inches (150 mm).
   c. Electrical Equipment Rating More Than 5 kVA: A minimum of 12 inches (300 mm).

4. Separation between communications cables in grounded metallic raceways and power lines and electrical equipment located in grounded metallic conduits or enclosures shall be as follows:

   a. Electrical Equipment Rating Less Than 2 kVA: No requirement.
   b. Electrical Equipment Rating between 2 and 5 kVA: A minimum of 3 inches (76 mm).
   c. Electrical Equipment Rating More Than 5 kVA: A minimum of 6 inches (150 mm).

5. Separation between Communications Cables and Electrical Motors and Transformers, 5 kVA or HP and Larger: A minimum of 48 inches (1200 mm).
6. Separation between Communications Cables and Fluorescent Fixtures: A minimum of 5 inches (127 mm).

3.6 FIRESTOPPING

A. Comply with requirements in Section 078413 "Penetration Firestopping."

B. Comply with TIA/EIA-569-A, Annex A, "Firestopping."

C. Comply with BICSI TDMM, "Firestopping Systems" Article.

3.7 GROUNDING

A. Install grounding according to BICSI TDMM, "Grounding, Bonding, and Electrical Protection" Chapter.

B. Comply with ANSI-J-STD-607-A.

C. Locate grounding bus bar to minimize the length of bonding conductors. Fasten to wall allowing at least 2-inch (50-mm) clearance behind the grounding bus bar. Connect grounding bus bar with a minimum No. 4 AWG grounding electrode conductor from grounding bus bar to suitable electrical building ground.

D. Bond metallic equipment to the grounding bus bar, using not smaller than No. 6 AWG equipment grounding conductor.

3.8 IDENTIFICATION

A. Identify system components, wiring, and cabling complying with TIA/EIA-606-A. Comply with requirements for identification specified in Section 260553 "Identification for Electrical Systems."

1. Administration Class: 2.
2. Color-code cross-connect fields and apply colors to voice and data service backboards, connections, covers, and labels.

B. Comply with requirements in Section 099123 "Interior Painting" for painting backboards. For fire-resistant plywood, do not paint over manufacturer's label.

C. Paint and label colors for equipment identification shall comply with TIA/EIA-606-A for Class 2 level of administration including optional identification requirements of this standard.

D. Comply with requirements in Section 271500 "Communications Horizontal Cabling" for cable and asset management software.

E. Cable Schedule: Install in a prominent location in each equipment room and wiring closet. List incoming and outgoing cables and their designations, origins, and destinations. Protect with rigid frame and clear plastic cover. Furnish an electronic copy of final comprehensive schedules for Project.

F. Cabling Administration Drawings: Show building floor plans with cabling administration-point labeling. Identify labeling convention and show labels for telecommunications closets, backbone pathways and cables, entrance pathways and cables, terminal hardware and positions, horizontal cables, work areas and workstation terminal positions, grounding buses and pathways, and equipment grounding conductors. Provide three (3) hard copies to owner; insure that copies are delivered as follows: one (1) to Utility Services, one (1) to Architectural Services, and one (1) to the School. Provide one (1) drawing in each equipment room and wiring closet and post in a prominent location. Protect each drawing with rigid frame and clear plastic cover.

G. Cable and Wire Identification:

1. Label each cable within 4 inches (100 mm) of each termination and tap, where it is accessible in a cabinet or junction or outlet box, and elsewhere as indicated.
2. Label each terminal strip and screw terminal in each cabinet, rack, or panel.

    a. Individually number wiring conductors connected to terminal strips and identify each cable or wiring group being extended from a panel or cabinet to a building-mounted device with name and number of particular device as shown.
    b. Label each unit and field within distribution racks and frames.

3. Identification within Connector Fields in Equipment Rooms and Wiring Closets: Label each connector and each discrete unit of cable-terminating and connecting hardware.

4. Meet with the Owner's Telecommunication personnel and coordinate labeling requirements prior to installation.

H. Labels shall be preprinted or computer-printed type with printing area and font color that contrasts with cable jacket color but still complies with requirements in TIA/EIA 606-A, for the following:

1. Cables use flexible vinyl or polyester that flexes as cables are bent.

3.9 FIELD QUALITY CONTROL

A. Testing Agency: Engage a qualified testing agency to perform tests and inspections.

B. Perform tests and inspections.

C. Tests and Inspections:

1. Visually inspect UTP and optical fiber jacket materials for NRTL certification markings. Inspect cabling terminations in communications equipment rooms for compliance with color-coding for pin assignments, and inspect cabling connections for compliance with TIA/EIA-568-B.1.
2. Visually inspect cable placement, cable termination, grounding and bonding, equipment and patch cords, and labeling of all components.
3. Test UTP copper cabling for DC loop resistance, shorts, opens, intermittent faults, and polarity between conductors. Test operation of shorting bars in connection blocks. Test cables after termination but not cross-connection.

    a. Test instruments shall meet or exceed applicable requirements in TIA/EIA-568-B.2. Perform tests with a tester that complies with performance requirements in "Test Instruments (Normative)" Annex, complying with measurement accuracy specified in "Measurement Accuracy (Informative)" Annex. Use only test cords and adapters that are qualified by test equipment manufacturer for channel or link test configuration.

4. Optical Fiber Cable Tests:

    a. Test instruments shall meet or exceed applicable requirements in TIA/EIA-568-B.1. Use only test cords and adapters that are qualified by test equipment manufacturer for channel or link test configuration.
    b. Link End-to-End Attenuation Tests:

        1) Horizontal and single mode backbone link measurements: Test at 850 or 1300 nm in 1 direction according to TIA/EIA-526-14-A, Method B, One Reference Jumper.
        2) Attenuation test results for backbone links shall be less than 2.0 dB. Attenuation test results shall be less than that calculated according to equation in TIA/EIA-568-B.1.

D. Data for each measurement shall be documented. Data for submittals shall be printed in a summary report that is formatted similar to Table 10.1 in BICSI TDMM, or transferred from the instrument to the computer, saved as text files, and printed and submitted.

E. Remove and replace cabling where test results indicate that they do not comply with specified requirements.

F. End-to-end cabling will be considered defective if it does not pass tests and inspections.

G. Prepare test and inspection reports.

3.10 MAINTENANCE AND REPAIR TRAINING

A. The contractor shall provide and implement a complete and comprehensive training program for all maintenance personnel. Trainer shall be a Level 2 installer.

B. This mandatory training program will provide a complete understanding of how to maintain and repair the system including but not limited to:

1. Installation.
2. Wiring.
3. Programming.
4. Administration.
5. Trouble shooting/repair.

C. All training is to be coordinated through the owner's designated representative. As training sessions are completed, the trainer will provide the school's administrative staff and school district's staff a document listing all of the maintenance personnel who attended, received, and completed the training program.

D. Provide quick reference guides.

END OF SECTION 27 13 00

SECTION 27 15 00 – COMMUNICATIONS HORIZONTAL CABLING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. UTP cabling.
2. Cable connecting hardware, patch panels, and cross-connects.
3. Telecommunications outlet/connectors.
4. Cabling system identification products.

B. Related Requirements:

1. Section 27 1300 "Communications Backbone Cabling" for voice and data cabling associated with system panels and devices.

1.3 DEFINITIONS

A. BICSI: Building Industry Consulting Service International.

B. Consolidation Point: A location for interconnection between horizontal cables extending from building pathways and horizontal cables extending into furniture pathways.

C. Cross-Connect: A facility enabling the termination of cable elements and their interconnection or cross-connection.

D. EMI: Electromagnetic interference.

E. IDC: Insulation displacement connector.

F. LAN: Local area network.

G. Outlet/Connectors: A connecting device in the work area on which horizontal cable or outlet cable terminates.

H. RCDD: Registered Communications Distribution Designer.

I. UTP: Unshielded twisted pair.

1.4 ADMINISTRATIVE REQUIREMENTS

A. Coordinate layout and installation of telecommunications cabling with Owner's telecommunications and LAN equipment and service suppliers.

B. Coordinate telecommunications outlet/connector locations with location of power receptacles at each work area.

1.5 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Shop Drawings:

1. System Labeling Schedules: Electronic copy of labeling schedules, in software and format selected by Owner.
2. System Labeling Schedules: Electronic copy of labeling schedules that are part of the cabling and asset identification system of the software.
3. Cabling administration drawings and printouts.
4. Wiring diagrams to show typical wiring schematics, including the following:

    a. Patch panels.
    b. Patch cords.

5. Patch panels. Detail mounting assemblies, and show elevations and physical relationship between the installed components.

C. Samples: For workstation outlets, jacks, jack assemblies, in specified finish, one for each size and outlet configuration and faceplates for color selection and evaluation of technical features.

1.6 INFORMATIONAL SUBMITTALS

A. Qualification Data: For installer, qualified layout technician, installation supervisor, and field inspector.

B. Source quality-control reports.

C. Field quality-control reports.

1.7 CLOSEOUT SUBMITTALS

A. Maintenance Data: For splices and connectors to include in maintenance manuals.

B. Software and Firmware Operational Documentation:

1. Software operating and upgrade manuals.
2. Program Software Backup: On magnetic media or compact disk, complete with data files.
3. Device address list.
4. Printout of software application and graphic screens.

C. Warranty documentation:

1. Include copy of final, executed warranties.
2. Contact information.

D. Data map.

E. Test results.

1.8 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. Patch-Panel Units: One of each type.
2. Device Plates: Ten of each type.

1.9 QUALITY ASSURANCE

A. Installer Qualifications: Cabling Installer must have personnel certified by BICSI on staff.

1. Layout Responsibility: Preparation of Shop Drawings, Cabling Administration Drawings, and field testing program development by an RCDD.
2. Installation Supervision: Installation shall be under the direct supervision of Level 2 Installer (copper and fiber), who shall be present at all times when Work of this Section is performed at Project site.
3. Testing Supervisor: Currently certified by BICSI as an RCDD to supervise on-site testing.

B. Testing Agency Qualifications: An NRTL.

1. Testing Agency's Field Supervisor: Currently certified by BICSI as an RCDD to supervise on-site testing.

1.10 DELIVERY, STORAGE, AND HANDLING

A. Test cables upon receipt at Project site.

1.11 WARRANTY

A. The system shall provide a 20-year warranty for applications, parts, and labor.

PART 2 - PRODUCTS

2.1 HORIZONTAL CABLING DESCRIPTION

A. Horizontal cable and its connecting hardware provide the means of transporting signals between the telecommunications outlet/connector and the horizontal cross-connect located in the communications equipment room. This cabling and its connecting hardware are called a "permanent link," a term that is used in the testing protocols.

1. TIA/EIA-568-B.1 requires that a minimum of two telecommunications outlet/connectors be installed for each work area.
2. Horizontal cabling shall contain no more than one transition point or consolidation point between the horizontal cross-connect and the telecommunications outlet/connector.
3. Bridged taps and splices shall not be installed in the horizontal cabling.

B. A work area is approximately 100 sq. ft. (9.3 sq. m), and includes the components that extend from the telecommunications outlet/connectors to the station equipment.

C. The maximum allowable horizontal cable length is 295 feet (90 m). This maximum allowable length does not include an allowance for the length of 16 feet (4.9 m) to the workstation equipment or in the horizontal cross-connect.

D. Topology: Star Configuration.

2.2 PERFORMANCE REQUIREMENTS

A. General Performance: Horizontal cabling system shall comply with transmission standards in TIA/EIA-568-B.1 when tested according to test procedures of this standard.

B. Surface-Burning Characteristics: Comply with ASTM E 84; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.

1. Flame-Spread Index: 25 or less.
2. Smoke-Developed Index: 450 or less.

C. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

D. Grounding: Comply with J-STD-607-A.

2.3 BACKBOARDS

A. Backboards: Plywood, fire-retardant treated, 3/4 by 48 by 96 inches (19 by 1220 by 2440 mm). Comply with requirements in Section 061000 "Rough Carpentry" for plywood backing panels.

2.4 UTP CABLE

A. Basis-of-Design Product: Subject to compliance with requirements, provide Mohawk GigaLAN 10 Augmented Cat 6A UTP or comparable product by one of the following:

1. Hitachi Cable America, Inc.
2. Optical Cable Corporation.
3. Superior Essex Inc.
4. Tyco Electronics Corporation; AMP Products.

B. Description: 100-ohm, four-pair UTP, covered with a thermoplastic jacket.

1. Comply with ICEA S-90-661 for mechanical properties.
2. Comply with TIA/EIA-568-B.1 for performance specifications.
3. Comply with TIA/EIA-568-B.2, Category 6A.

4. Listed and labeled by an NRTL acceptable to authorities having jurisdiction as complying with UL 444 and NFPA 70 for the following types:

   a. Communications, Plenum Rated: Type CMP, complying with NFPA 262.
   b. Communications, Riser Rated: Type CMR, complying with UL 1666.

5. Provide shielded cables for all wireless access points.

6. Jacket colors:

   a. See drawings for color requirements.

2.5 UTP CABLE HARDWARE

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

   1. Leviton Commercial Networks Division.
   2. Tyco Electronics Corporation; AMP Products.

B. General Requirements for Cable Connecting Hardware: Comply with TIA/EIA-568-B.2, IDC type, with modules designed for punch-down caps or tools. Cables shall be terminated with connecting hardware of same category or higher.

C. Patch Panel: Modular panels housing multiple-numbered jack units with IDC-type connectors at each jack for permanent termination of pair groups of installed cables.

   1. Number of Jacks per Field: One for each four-pair UTP cable indicated.
   2. Rating: Category 6A.

D. Jacks and Jack Assemblies: Modular, color-coded, eight-position modular Category 6A receptacle units with integral IDC-type terminals.

E. Patch Cords: Provide factory-made, 4-pair cables. 80% of the patch cords shall be 36-inch (914-mm) and the remaining 20% shall be 60-inch (1524-mm) for each patch panel to patch panel connection; terminated with 8-position modular plug at each end. 120-inch (3048-mm) patch cords shall be provided at desk-top (user) locations.

   1. Patch cords shall have bend-relief-compliant boots and color-coded icons to ensure Category 6A performance. Patch cords shall have latch guards to protect against snagging.
   2. Patch cords shall be color-coded to match color of system for circuit identification.

2.6 TELECOMMUNICATIONS OUTLET/CONNECTORS

A. Jacks: 100-ohm, balanced, twisted-pair connector; four-pair, eight-position Category 6A modular. Comply with TIA/EIA-568-B.1.

   Workstation Outlets: One, two, or three port-connector assemblies as indicated on drawings mounted in single faceplate.

   1. Metal Faceplate: Brushed Stainless steel, complying with requirements in Section 260140 "Wiring Devices."
   2. For use with snap-in jacks accommodating UTP, work area cords.

a. Flush mounting jacks, positioning the cord at a 45-degree angle.

3. Legend: Machine printed, in the field, using adhesive-tape label, clear with black letters.

2.7 GROUNDING

A. Comply with requirements in Section 270526 "Grounding and Bonding for Communications Systems" for grounding conductors and connectors.

B. Comply with J-STD-607-A.

2.8 IDENTIFICATION PRODUCTS

A. Comply with TIA/EIA-606-A and UL 969 for labeling materials, including label stocks, laminating adhesives, and inks used by label printers.

2.9 SOURCE QUALITY CONTROL

A. Testing Agency: Engage a qualified testing agency to evaluate cables.

B. Factory test UTP cables on reels according to TIA/EIA-568-B.1.

C. Factory test UTP cables according to TIA/EIA-568-B.2.

D. Cable will be considered defective if it does not pass tests and inspections.

E. Prepare test and inspection reports.

PART 3 - EXECUTION

3.1 ENTRANCE FACILITIES

A. Coordinate backbone cabling with the protectors and demarcation point provided by communications service provider.

3.2 PRECONSTRUCTION MEETING

A. **Attend a Preconstruction Meeting with the Owner to review installation standards prior to doing any work.**

3.3 WIRING METHODS

A. Install cables in raceways and cable trays except within consoles, cabinets, desks, counters, and accessible lay-in tile accessible ceilings. Install cabling with horizontal and vertical cable guides in telecommunications spaces with terminating hardware and interconnection equipment. Where cables are routed in accessible lay-in tile suspended ceilings, secure and support cables with J-hooks a minimum of 8 inches (200 mm) above ceilings and not more than 60 inches (1524 mm) apart; cable shall not be run through structural members or in contact with

pipes, ducts, or other potentially damaging items. Install cables in open ceilings (finished and unfinished) in raceways. Where raceways are installed in finished ceilings, paint raceways to match the color of the surrounding surface.

1. Install plenum cable in environmental air spaces, including plenum ceilings.
2. Comply with requirements in Section 260110 "Conduit Raceways." Minimum raceway size is 1".
3. Comply with requirements in Section 260111 "Cable Trays."

B. Wiring within Enclosures:

1. Bundle, lace, and train conductors to terminal points with no excess and without exceeding manufacturer's limitations on bending radii.
2. Install lacing bars and distribution spools.
3. Install conductors parallel with or at right angles to sides and back of enclosure.

3.4 INSTALLATION OF CABLES

A. Comply with NECA 1.

B. General Requirements for Cabling:

1. Comply with TIA/EIA-568-B.1.
2. Comply with BICSI ITSIM, Ch. 6, "Cable Termination Practices."
3. Make terminations only at indicated outlets, terminals, cross-connects, and patch panels.
4. Cables may not be spliced. Secure and support cables at intervals not exceeding 30 inches (760 mm) and not more than 6 inches (150 mm) from cabinets, boxes, fittings, outlets, racks, frames, and terminals.
5. Install lacing bars to restrain cables, to prevent straining connections, and to prevent bending cables to smaller radii than minimums recommended by manufacturer.
6. Bundle, lace, and train conductors to terminal points without exceeding manufacturer's limitations on bending radii, but not less than radii specified in BICSI ITSIM, "Cabling Termination Practices" Chapter. Install lacing bars and distribution spools.
7. Do not install bruised, kinked, scored, deformed, or abraded cable. Do not splice cable between termination, tap, or junction points. Remove and discard cable if damaged during installation and replace it with new cable.
8. Cold-Weather Installation: Bring cable to room temperature before dereeling. Heat lamps shall not be used for heating.
9. In the communications equipment room, install a 10-foot- (3-m-) long service loop on each end of cable.
10. Pulling Cable: Comply with BICSI ITSIM, Ch. 4, "Pulling Cable." Monitor cable pull tensions.

C. UTP Cable Installation:

1. Comply with TIA/EIA-568-B.2.
2. Do not untwist UTP cables more than 1/2 inch (12 mm) from the point of termination to maintain cable geometry.

D. Group connecting hardware for cables into separate logical fields.

E. Separation from EMI Sources:

1. Comply with BICSI TDMM and TIA-569-B for separating unshielded copper voice and data communication cable from potential EMI sources, including electrical power lines and equipment.
2. Separation between open communications cables or cables in nonmetallic raceways and unshielded power conductors and electrical equipment shall be as follows:

    a. Electrical Equipment Rating Less Than 2 kVA: A minimum of 5 inches (127 mm).
    b. Electrical Equipment Rating between 2 and 5 kVA: A minimum of 12 inches (300 mm).
    c. Electrical Equipment Rating More Than 5 kVA: A minimum of 24 inches (610 mm).

3. Separation between communications cables in grounded metallic raceways and unshielded power lines or electrical equipment shall be as follows:

    a. Electrical Equipment Rating Less Than 2 kVA: A minimum of 2-1/2 inches (64 mm).
    b. Electrical Equipment Rating between 2 and 5 kVA: A minimum of 6 inches (150 mm).
    c. Electrical Equipment Rating More Than 5 kVA: A minimum of 12 inches (300 mm).

4. Separation between communications cables in grounded metallic raceways and power lines and electrical equipment located in grounded metallic conduits or enclosures shall be as follows:

    a. Electrical Equipment Rating Less Than 2 kVA: No requirement.
    b. Electrical Equipment Rating between 2 and 5 kVA: A minimum of 3 inches (76 mm).
    c. Electrical Equipment Rating More Than 5 kVA: A minimum of 6 inches (150 mm).

5. Separation between Communications Cables and Electrical Motors and Transformers, 5 kVA or HP and Larger: A minimum of 48 inches (1200 mm).
6. Separation between Communications Cables and Fluorescent Fixtures: A minimum of 5 inches (127 mm).

3.5 FIRESTOPPING

A. Comply with requirements in Section 078413 "Penetration Firestopping."

B. Comply with TIA-569-B, Annex A, "Firestopping."

C. Comply with BICSI TDMM, "Firestopping Systems" Article.

3.6 GROUNDING

A. Install grounding according to BICSI TDMM, "Grounding, Bonding, and Electrical Protection" Chapter.

B. Comply with J-STD-607-A.

C. Locate grounding bus bar to minimize the length of bonding conductors. Fasten to wall allowing at least 2-inch (50-mm) clearance behind the grounding bus bar. Connect grounding bus bar with a minimum No. 4 AWG grounding electrode conductor from grounding bus bar to suitable electrical building ground.

D. Bond metallic equipment to the grounding bus bar, using not smaller than No. 6 AWG equipment grounding conductor.

E. Ground shields of all shielded twisted pair cables in accordance with all manufacturer's written instructions.

3.7 IDENTIFICATION

A. Identify system components, wiring, and cabling complying with TIA/EIA-606-A. Comply with requirements for identification specified in Section 260553 "Identification for Electrical Systems."

1. Administration Class: 2.
2. Color-code cross-connect fields. Apply colors to voice and data service backboards, connections, covers, and labels.

B. Comply with requirements in Section 099123 "Interior Painting" for painting backboards. For fire-resistant plywood, do not paint over manufacturer's label.

C. Paint and label colors for equipment identification shall comply with TIA/EIA-606-A for Class 2 level of administration, including optional identification requirements of this standard.

D. Cable Schedule: Post in prominent location in each equipment room and wiring closet. List incoming and outgoing cables and their designations, origins, and destinations. Protect with rigid frame and clear plastic cover. Furnish an electronic copy of final comprehensive schedules for Project.

E. Cabling Administration Drawings: Show building floor plans with cabling administration-point labeling. Identify labeling convention and show labels for telecommunications closets, backbone pathways and cables, entrance pathways and cables, terminal hardware and positions, horizontal cables, work areas and workstation terminal positions, grounding buses and pathways, and equipment grounding conductors. Follow convention of TIA/EIA-606-A. Furnish electronic record of all drawings, in software and format selected by Owner. Provide three (3) hard copies to owner. Provide one (1) drawing in each equipment room and wiring closet and post in a prominent location. Protect with rigid frame and clear plastic cover.

F. Cable and Wire Identification:

1. Label each cable within 4 inches (100 mm) of each termination and tap, where it is accessible in a cabinet or junction or outlet box, and elsewhere as indicated.
2. Label each terminal strip and screw terminal in each cabinet, rack, or panel.

    a. Individually number wiring conductors connected to terminal strips, and identify each cable or wiring group being extended from a panel or cabinet to a building-mounted device shall be identified with name and number of particular device as shown.
    b. Label each unit and field within distribution racks and frames.

3. Identification within Connector Fields in Equipment Rooms and Wiring Closets: Label each connector and each discrete unit of cable-terminating and connecting hardware.
4. Meet with The Owner's Telecommunications personnel and coordinate labeling requirements prior to installation.

5. For cable drop/jack for each wireless access point, provide a Kory label on the ceiling grid nearest the radio indicating the distribution rack and circuit number.

G. Labels shall be preprinted or computer-printed type with printing area and font color that contrasts with cable jacket color but still complies with requirements in TIA/EIA-606-A.

1. Cables use flexible vinyl or polyester that flex as cables are bent.

3.8 FIELD QUALITY CONTROL

A. Manufacturer's Field Service: Engage a factory-authorized service representative to test and inspect components, assemblies, and equipment installations, including connections.

B. Perform the following tests and inspections with the assistance of a factory-authorized service representative:

1. Visually inspect UTP and optical fiber cable jacket materials for NRTL certification markings. Inspect cabling terminations in communications equipment rooms for compliance with color-coding for pin assignments, and inspect cabling connections for compliance with TIA/EIA-568-B.1.
2. Visually confirm Category 6A, marking of outlets, cover plates, outlet/connectors, and patch panels.
3. Visually inspect cable placement, cable termination, grounding and bonding, equipment and patch cords, and labeling of all components.
4. Test UTP backbone copper cabling for DC loop resistance, shorts, opens, intermittent faults, and polarity between conductors. Test operation of shorting bars in connection blocks. Test cables after termination but not cross-connection.

   a. Test instruments shall meet or exceed applicable requirements in TIA/EIA-568-B.2. Perform tests with a tester that complies with performance requirements in "Test Instruments (Normative)" Annex, complying with measurement accuracy specified in "Measurement Accuracy (Informative)" Annex. Use only test cords and adapters that are qualified by test equipment manufacturer for channel or link test configuration.

5. UTP Performance Tests:

   a. Test for each outlet and MUTOA. Perform the following tests according to TIA/EIA-568-B.1 and TIA/EIA-568-B.2:

      1) Wire map.
      2) Length (physical vs. electrical, and length requirements).
      3) Insertion loss.
      4) Near-end crosstalk (NEXT) loss.
      5) Power sum near-end crosstalk (PSNEXT) loss.
      6) Equal-level far-end crosstalk (ELFEXT).
      7) Power sum equal-level far-end crosstalk (PSELFEXT).
      8) Return loss.
      9) Propagation delay.
      10) Delay skew.

6. Final Verification Tests: Perform verification tests for UTP systems after the complete communications cabling and workstation outlet/connectors are installed.

   a. Voice Tests: These tests assume that dial tone service has been installed. Connect to the network interface device at the demarcation point. Go off-hook and

listen and receive a dial tone. If a test number is available, make and receive a local, long distance, and digital subscription line telephone call.

b. Data Tests: These tests assume the Information Technology Staff has a network installed and is available to assist with testing. Connect to the network interface device at the demarcation point. Log onto the network to ensure proper connection to the network.

C. Document data for each measurement. Data for submittals shall be printed in a summary report that is formatted similar to Table 10.1 in BICSI TDMM, or transferred from the instrument to the computer, saved as text files, and printed and submitted.

D. End-to-end cabling will be considered defective if it does not pass tests and inspections.

E. Prepare test and inspection reports.

3.9 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel in cable-plant management operations, including changing signal pathways for different workstations, rerouting signals in failed cables, and keeping records of cabling assignments and revisions when extending wiring to establish new workstation outlets.

3.10 MAINTENANCE AND REPAIR TRAINING

A. The contractor shall provide and implement a complete and comprehensive training program for all maintenance personnel. Trainer shall be a Level 2 installer.

B. This mandatory training program will provide a complete understanding of how to maintain and repair the system including but not limited to:

1. Installation.
2. Wiring.
3. Programming.
4. Administration.
5. Trouble shooting/repair.

C. All training is to be coordinated through the owner’s designated representative. As training sessions are completed, the trainer will provide the school’s administrative staff and school district’s staff a document listing all of the maintenance personnel who attended, received, and completed the training program.

D. Provide quick reference guides.

END OF SECTION 27 15 00

SECTION 27 31 00 - PUBLIC SAFETY DISTRIBUTED ANTENNA SYSTEM

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. Bi-directional amplifiers
   2. In-building service antennas
   3. Outdoor donor antenna
   4. Coaxial cabling
   5. Couplers and splitters

1.3 DEFINITIONS

A. DAS: Distributed Antenna System.

B. BDA: Bi-directional Amplifier.

1.4 ACTION SUBMITTALS

A. Qualification Data: For Designers and Field Technicians.

B. Product Data: For each type of product indicated.
   1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes (including available colors) for each product indicated and describe features and operating sequences, for the all system products.
   2. Include approvals and listings, construction details, material descriptions, dimensions, profiles, and finishes.
   3. Include rated capacities, operating characteristics, and electrical characteristics.

C. Shop Drawings: For DAS system. Include plans, elevations, sections, details, and attachments to other work.
   1. Wiring Diagrams: For power, grounding, and signal wiring.
      a. Identify terminals and wiring color codes to facilitate installation, operation, and maintenance.
      b. Indicate recommended wire types and sizes, and circuiting arrangements for field-installed system wiring.
   2. Details of seismic restraints including mounting, anchoring, and fastening devices for the following system components:
      a. Bi-directional amplifier
      b. Antennas
   3. Heat mapping layout drawings showing calculated levels, antenna and equipment locations as well as cable routing.

4. Dimensioned Outline Drawings of the Bi-directional amplifier.

D. Delegated-Design Submittal: For the public safety distributed antenna system indicated to comply with performance requirements and design criteria, including heat mapping analysis data/layouts.
   1. Design Calculations / Layouts: Perform heat mapping calculations to determine system design based upon actual existing site signal strength and building construction.

1.5 APPROVAL TESTING SUBMITTALS

A. Statement of Completion: Written statement that system has been installed in accordance with approved plans and tested in accordance with the manufacturer's published instructions and appropriate NFPA 72/1221 requirements.

B. Record of Inspection and Testing. Detailed documentation of completed acceptance testing.

1.6 CLOSEOUT SUBMITTALS

A. Record Drawings. Provide complete Shop Drawing re-submittal updated to reflect actual final system installation and sequence of operation of all components.

B. Operation and Maintenance Data: For DAS to include in emergency, operation, and maintenance manuals.
   1. Provide manufacturer's Owner's Operation and Maintenance Manuals with required related system warranty requirements.
   2. Provide Record of Inspection and Testing.

1.7 QUALITY ASSURANCE

A. Designer and Field Technician Qualifications: Personnel trained and certified by the TRCES manufacturer as an approved technician; and as required by the AHJ, in possession of a professional engineering license, radio licensing authority license, and/or industry certification. Will be installed by competent, experienced installers in accordance with industry best practices, Authority Having Jurisdiction, and relevant codes. Contractor must have at least 5 years' experience of successful DAS installations of similar scope, size and type

B. Source Limitations for TRCES: Single vendor source to provide TRCES components as a complete code-compliant, tested and functioning TRCES.

C. Electrical Components, Devices, and Accessories: Approved by the AHJ and listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
   1. Products: Specific Agency Requirements for All RF emitting devices certified by the Radio Licensing Authority.

1.8 INSTALLER

A. Approved Installers:
   1. Hunt Electric. Jared Vance, 801-420-1455
   2. Pierson Wireless Corp. Ross Pierson, 402-730-8638
   3. Cache Valley Electric Teledata Division, Jason Dille, 801-908-4167

4. Wasatch Electric Comtech Division, Mark Varner, 801-478-2237
5. Groove Technology Solutions, Jim Henderson, 801-368-3837
6. No other approved installers without written prior approval by engineer and owner.

1.9 WARRANTY

A. Installer and/or Manufacturer agrees to repair or replace system equipment and components that fail in materials or workmanship within specified warranty period.

B. Warranty Period: Two (2) years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 BI-DIRECTIONAL AMPLIFIER

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   1. Westell PS51080 NFPA 72 Public Safety Signal Booster
   2. Prior approved equivalent

B. NEMA Type 4 Enclosure for BDA and battery backup.

C. Will provide 12 hours minimum of runtime at 100% power.

D. Automatically charge while AC power is available.

E. Low battery and AC off alarm outputs

2.2 IN-BUILDING SERVICE ANTENNAS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   1. Gamma Nu
   2. ADRF
   3. Galtronics

B. General: Wideband omnidirectional, multi-band type, low-profile ceiling mount, white finish.

C. Plenum application fire test listing: UL 2043.

2.3 COUPLERS AND SPLITTERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   1. CommScope
   2. Westell

B. General: 50 Ohm RF couplers and splitters; bandwidth and dB rating as required by BDA performance requirements.

2.4 CONDUCTORS AND CABLES

A. Conductors: Coax Cabling. Sizes and types as recommended by system manufacturer.

B. Comply with NFPA 70, NFPA 72/1221, and requirements of authorities having jurisdiction.

C. Conductor Color-Coding: Uniformly identified and coordinated with wiring diagrams.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Comply with the most restrictive requirements of this Section and applicable Division 26 and 27 sections for the installation of low voltage electrical systems.

B. Comply with NFPA 72/1221, and requirements of authorities having jurisdiction for installation and testing of TRCES. Install all electrical wiring to comply with requirements in NFPA 70.

C. Arrange equipment cabinets, wire-ways, and conduits with adequate clearances to facilitate access for inspection, maintenance, and component replacement.

D. Install equipment cabinets with top and bottom of cabinets not more than 72 inches above finished floor and not less than 12 inches above finished floor, respectively.

E. Install battery cabinets with top and bottom of cabinets not more than 48 inches above finished floor and not less than 12 inches above finished floor, respectively.

F. Install equipment cabinets with user displays and/or controls including fire alarm control unit nodes and remote annunciators with displays and/or controls at natural user height.

G. Flush-mount equipment cabinets/back-boxes not located in designated equipment rooms.

H. Surface-mount equipment cabinets/back-boxes located in designated equipment rooms unless noted to be installed inside racks or by other methods.

I. Install outdoor donor antenna with clear view to donor site with a minimum 2-ft vertical clearance above nearby obstacles.

J. Secure outdoor donor antenna to mounting mast in accordance with manufacturer requirements.

K. Install NFPA 780 compliant lighting protection at connection to outdoor donor antenna.

3.2 WIRING METHODS

A. Wiring Method: Install cables in raceways. Cables for DAS shall not be installed inside telecommunications cable tray system, but shall be provided with a separate raceway/support system. Conceal raceway and cables except in unfinished spaces.
   1. Install plenum cable in environmental air spaces, including plenum ceilings.
   2. Comply with requirements for raceways and boxes specified in Section 270528 "Pathways for Communications Systems."

B. Comply with NFPA 70, NFPA 72/1221, and requirements of authorities having jurisdiction.

C. Wiring Method: Conceal conductors and cables in accessible ceilings, walls, and floors where possible.

D. Wiring within Enclosures: Bundle, lace, and train cables to terminal points with no excess and without exceeding manufacturer's limitations on bending radii. Provide and use lacing bars and distribution spools.

E. Support cables not enclosed in raceways on J-Hooks. Install, size, and space J-Hooks to comply with TIA-568-C. J-hooks may only be used above accessible lay-in ceilings.

F. Comply with Division 26 and with each DAS component's manufacturer installation guidelines for grounding and bonding. See drawings for additional details.

3.3 IDENTIFICATION

A. Identify system components, wiring, cabling, and terminals. Comply with Division 26 and with Section 270553 "Identification for Communications Systems."

B. Color-code wires, and apply wire and cable marking tape to designate wires and cables so they are uniformly identified and coordinated with wiring diagrams throughout the system.

C. Comply with AHJ requirements for TRCES component identification.

3.4 FIELD QUALITY CONTROL

A. Perform tests and inspections.
   1. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect components, assemblies, and equipment installations, including connections, and to assist in testing.

B. Tests and Inspections:
   1. Perform operational-system tests to verify compliance with the Specifications and make adjustments to bring system into compliance. Include all programming.
   2. Verify that units and controls are properly labeled and interconnecting wires and terminals are identified.

C. Components installed but not yet placed in service shall be protected from construction dust, debris, dirt, moisture, and damage according to manufacturer's written storage instructions.

D. Perform visual inspections in accordance with NFPA 72/1221. Correct deficiencies.

E. Perform functional testing in accordance with NFPA 72/1221 and AHJ requirements for plotted interior building RF signal strength and/or delivered audio quality (DAQ) score. Correct deficiencies.

F. Document 100 percent satisfactory functional tests via AHJ approved report format.

G. Perform acceptance field testing. Demonstrate system operation to the satisfaction of the AHJ.

H. DAS system will be considered defective if it does not pass tests and inspections.

I. Place system into normal operating service without system faults or outstanding work.

J. Prepare test and inspection reports.

3.5 ADJUSTING

A. Occupancy Adjustments: When requested within 12 months of 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.

3.6 DEMONSTRATION

A. Train Owner's maintenance personnel to adjust, operate, and maintain DAS system components.

END OF SECTION 26 31 00

Louisa May Alcott
Community School

SECTION 27 51 15 – AUDIO SYSTEMS

PART 1 - GENERAL

1.1 SUMMARY

A. Includes But Not Limited To:
   1. Furnish and install complete and operational sound systems as described in Contract Documents to include all equipment and materials, whether specifically mentioned herein or not, to ensure complete and operational systems.
   2. Assist Audio / Video Consultant with final inspection and equalization of system and provide necessary test equipment for sound system and partition noise isolation tests. Correct problems found at time of final inspection of system.

B. Related Requirements:
   1. Division 26:
      a. Raceways, boxes, and fittings.
   2. Audio / Video Consultant will perform final inspection, system balance, and equalization.

1.2 ADMINISTRATIVE REQUIREMENTS

A. Coordination:
   1. Coordinate final inspection schedule with Audio / Video Consultant three weeks minimum before Consultant's final inspection.

1.3 SUBMITTALS

A. Informational Submittals:
   1. Itemized list of equipment to be supplied with product data sheets
   2. Shop drawings
   3. System programming

B. Closeout Submittals:
   1. Include following in Operations And Maintenance Manual:
      a. Operations and Maintenance Data:
         1) Equipment Manufacture's manual:
            a) Sound system operation and maintenance instructions.
            b) List of equipment provided, including portable equipment, showing make, model, and serial number.
      b. Warranty Documentation:
         1) Include copy of final, executed warranties.
         2) Contact information.
      c. Record Documentation:
         1) Software and Programming: Copies of all manufacturers' software used for programming various components and functions of the system shall be furnished to the Owner:
            a) Original source codes and compiled codes used for system control, audio setup and any other computerized functions of the system including screen layout generation, configuration and layouts and any other related computer files shall also be furnished to the Owner.
            b) In each and every case, all programming, code generation, configuration files, layout files and any other software and/or code written and generated of the setup and operation of this system are the property of the Owner of the system and not of the consultant, contractor or integrator.

2) Testing results.
3) Hardware locations and configurations.

1.4 QUALITY ASSURANCE

A. Qualifications: Requirements is not limited to following:
1. Installers Qualifications:
a. Approved Installers. Specified installers are to both furnish and install components of sound system.
1) General Communications: (801) 266-5731.
2) Marshall Industries: (801) 266-2428.
3) Poll Sound: (801) 261-2500.
4) Summit Fire, (801)295-1189
5) Bids submitted by non-pre-qualified bidders will not be accepted.
b. Installer's Qualifications:
1) The work of this section will be contracted to a single firm, referred to as the Sound Installer for undivided responsibility.
2) The Sound Installer must be experienced in the installation of professional sound systems and have completed within the past five years at least five sound system projects of a size and scope comparable to the project described herein.
3) The Sound Installer shall have capabilities and in-house facilities for installation, shop fabrication and repair service of professional sound systems.
4) The Sound Installer shall have on his full-time payroll at least one staff engineer having five years minimum experience as an Audio and Video engineer. In place of a qualified staff engineer, the Sound Installer may retain a consulting engineer to direct the project. Prior to bid acceptance, the qualifications of the consulting engineer shall be submitted for the approval of the Consultant. Said staff or consulting engineer shall:
5) Provide all technical liaisons between the Sound Installer and the Consultant.
6) Represent the Sound Installer at meetings and conferences, and be present at the job site for final inspection/
7) Be responsible for supervision of all technical and engineering work required executing the contract, and in particular, approving and signing of all shop drawings.
8) Must be a dealer or distributor of equipment included in bid and provide documents from manufacturers stating such.
9) Outline the general scope of past project, normal staffing levels, and union status of shop and field installation personnel.
10) List a minimum of three (3) projects of similar scope successfully completed, indicating the location, type of system installed, total contract amount, date completed, and include persons and telephone number to contact.
11) Submit confirmation of current state or local contracting licenses, as required to perform the work under this section.
2. Manufacturer's Qualifications:
a. Firms regularly engaged in manufacture of sound system components and accessories for more than 5 years.

1.5 EXTRA MATERIALS

A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents. Refer to drawings for descriptions and quantities of extra material required. Except for major head-end equipment, at least 3% spare materials but not less than one whole unit of each type of input or output device shall be provided whether indicated or not.

1.6 WARRANTY

A. Special Warranty:
   1. Provide complete warranty repair or replacement for one year at no cost to Owner, except in case of obvious abuse.
   2. Honor component warranties for term established by Manufacturer, if greater than one year.
   3. Activate all manufacturers' equipment warranties in Owner's name to commence on the date of acceptance.
   4. Contractor shall respond, excluding weekends and holidays, within 24 hours to any warranty service calls. If equipment cannot be repaired within 24 hours of service visit, the contractor shall provide "loaner" equipment to the facility at no charge. Response shall be defined as a visit to the site; a phone call is not acceptable. The response time of 24 hours is defined to mean one day, not three business days.
   5. If, during the warranty period, any component is out of service for more than one week due to unavailability of parts or service, supply and install an identical new component. If an identical component is not available, substitute equivalent equipment, but only with approval of the Owner.
   6. When equipment is removed from the school for warranty repair or replacement, provide documentation filed with the school including description of part, serial number, estimated return date of equipment, and technician contact information.

PART 2 - PRODUCTS

2.1 SYSTEM

A. Product are specified on drawings.

PART 3 - EXECUTION

3.1 FIELD COOPERATION

A. Cooperate at all times, and to the fullest extent, with all trades during work to the end that lost time, work stoppages, interference, and inefficiencies do not occur.

3.2 SHOP DRAWINGS SUBMITTALS

A. Submit shop drawings of systems prior to fabrication:
   1. System functional block drawings including all equipment names and model numbers.
   2. Provide full scale drawings of all custom plates and panels indicating exact lettering, critical dimensions, and finish.
   3. Provide a list of test equipment, including manufacturer, description and model number of the test equipment expected to be employed in the test and adjustment of the systems.

3.3 EXAMINATION

A. Verification Of Conditions:
   1. Verify compliance with following items before beginning work of this Section.
      a. No cables spliced.
      b. Isolated grounds run back to electrical panel from all equipment cabinets.
      c. Specified conduit, cables, speaker enclosures and equipment cabinets are properly installed.

3.4 PRECONSTRUCTION MEETING: Attend a Preconstruction Meeting with the Owner to review installation standards prior to doing any work.

3.5 WIRING METHODS

A. Install cables in raceways and cable trays except within consoles, cabinets, desks, counters, and accessible lay-in tile accessible ceilings. Install cabling with horizontal and vertical cable guides in telecommunications spaces with terminating hardware and interconnection equipment. Where cables are routed in accessible lay-in tile suspended ceilings, secure and support cables with J-hooks a minimum of 8 inches (200 mm) above ceilings and not more than 60 inches (1524 mm) apart; cable shall not be run through structural members or in contact with pipes, ducts, or other potentially damaging items. Install cables in open ceilings (finished and unfinished) in raceways. Where raceways are installed in finished ceilings, paint raceways to match the color of the surrounding surface.

1. Install plenum cable in environmental air spaces, including plenum ceilings.
2. Comply with requirements in Section 260110 "Conduit Raceways." Minimum raceway size is 3/4".
3. Comply with requirements in Section 260111 "Cable Trays."

B. Wiring within Enclosures:

1. Bundle, lace, and train conductors to terminal points with no excess and without exceeding manufacturer's limitations on bending radii.
2. Install lacing bars and distribution spools.
3. Install conductors parallel with or at right angles to sides and back of enclosure.

3.6 INSTALLATION OF CABLES

A. Comply with NECA 1.

B. General Requirements for Cabling:

1. Comply with TIA/EIA-568-B.1.
2. Comply with BICSI ITSIM, Ch. 6, "Cable Termination Practices."
3. Make terminations only at indicated outlets, terminals, cross-connects, and patch panels.
4. Cables may not be spliced. Secure and support cables at intervals not exceeding 30 inches (760 mm) and not more than 6 inches (150 mm) from cabinets, boxes, fittings, outlets, racks, frames, and terminals.
5. Install lacing bars to restrain cables, to prevent straining connections, and to prevent bending cables to smaller radii than minimums recommended by manufacturer.
6. Bundle, lace, and train conductors to terminal points without exceeding manufacturer's limitations on bending radii, but not less than radii specified in BICSI ITSIM, "Cabling Termination Practices" Chapter. Install lacing bars and distribution spools.
7. Do not install bruised, kinked, scored, deformed, or abraded cable. Do not splice cable between termination, tap, or junction points. Remove and discard cable if damaged during installation and replace it with new cable.
8. Cold-Weather Installation: Bring cable to room temperature before de-reeling. Heat lamps shall not be used for heating.
9. In the communications equipment room, install a 10-foot- (3-m-) long service loop on each end of cable.
10. Pulling Cable: Comply with BICSI ITSIM, Ch. 4, "Pulling Cable." Monitor cable pull tensions.

C. UTP Cable Installation:

1. Comply with TIA/EIA-568-B.2.
2. Do not untwist UTP cables more than 1/2 inch (12 mm) from the point of termination to maintain cable geometry.

D. Group connecting hardware for cables into separate logical fields.

E. Separation from EMI Sources:

1. Comply with BICSI TDMM and TIA-569-B for separating unshielded copper voice and data communication cable from potential EMI sources, including electrical power lines and equipment.
2. Separation between open communications cables or cables in nonmetallic raceways and unshielded power conductors and electrical equipment shall be as follows:

   a. Electrical Equipment Rating Less Than 2 kVA: A minimum of 5 inches (127 mm).
   b. Electrical Equipment Rating between 2 and 5 kVA: A minimum of 12 inches (300 mm).
   c. Electrical Equipment Rating More Than 5 kVA: A minimum of 24 inches (610 mm).

3. Separation between communications cables in grounded metallic raceways and unshielded power lines or electrical equipment shall be as follows:

   a. Electrical Equipment Rating Less Than 2 kVA: A minimum of 2-1/2 inches (64 mm).
   b. Electrical Equipment Rating between 2 and 5 kVA: A minimum of 6 inches (150 mm).
   c. Electrical Equipment Rating More Than 5 kVA: A minimum of 12 inches (300 mm).

4. Separation between communications cables in grounded metallic raceways and power lines and electrical equipment located in grounded metallic conduits or enclosures shall be as follows:

   a. Electrical Equipment Rating Less Than 2 kVA: No requirement.
   b. Electrical Equipment Rating between 2 and 5 kVA: A minimum of 3 inches (76 mm).
   c. Electrical Equipment Rating More Than 5 kVA: A minimum of 6 inches (150 mm).

5. Separation between Communications Cables and Electrical Motors and Transformers, 5 kVA or HP and Larger: A minimum of 48 inches (1200 mm).
6. Separation between Communications Cables and Fluorescent Fixtures: A minimum of 5 inches (127 mm).

3.7 FIRESTOPPING

A. Comply with requirements in Section 078413 "Penetration Firestopping."

B. Comply with TIA-569-B, Annex A, "Firestopping."

C. Comply with BICSI TDMM, "Firestopping Systems" Article.

3.8 GROUNDING

A. Install grounding according to BICSI TDMM, "Grounding, Bonding, and Electrical Protection" Chapter.

B. Comply with J-STD-607-A.

C. Locate grounding bus bar to minimize the length of bonding conductors. Fasten to wall allowing at least 2-inch (50-mm) clearance behind the grounding bus bar. Connect grounding bus bar with a minimum No. 4 AWG grounding electrode conductor from grounding bus bar to suitable electrical building ground.

D. Bond metallic equipment to the grounding bus bar, using not smaller than No. 6 AWG equipment grounding conductor.

3.9 IDENTIFICATION

A. Identify system components, wiring, and cabling complying with TIA/EIA-606-A. Comply with requirements for identification specified in Section 260553 "Identification for Electrical Systems."

1. Administration Class: 2.
2. Color-code cross-connect fields. Apply colors to voice and data service backboards, connections, covers, and labels.

B. Comply with requirements in Section 099123 "Interior Painting" for painting backboards. For fire-resistant plywood, do not paint over manufacturer's label.

C. Paint and label colors for equipment identification shall comply with TIA/EIA-606-A for Class 2 level of administration, including optional identification requirements of this standard.

D. Cable Schedule: Post in prominent location in each equipment room and wiring closet. List incoming and outgoing cables and their designations, origins, and destinations. Protect with rigid frame and clear plastic cover. Furnish an electronic copy of final comprehensive schedules for Project.

E. Cabling Administration Drawings: Show building floor plans with cabling administration-point labeling. Identify labeling convention and show labels for telecommunications closets, backbone pathways and cables, entrance pathways and cables, terminal hardware and positions, horizontal cables, work areas and workstation terminal positions, grounding buses and pathways, and equipment grounding conductors. Follow convention of TIA/EIA-606-A. Furnish electronic record of all drawings, in software and format selected by Owner. Provide three (3) hard copies to owner. Provide one (1) drawing in each equipment room and wiring closet and post in a prominent location. Protect with rigid frame and clear plastic cover.

F. Cable and Wire Identification:

1. Label each cable within 4 inches (100 mm) of each termination and tap, where it is accessible in a cabinet or junction or outlet box, and elsewhere as indicated.
2. Label each terminal strip and screw terminal in each cabinet, rack, or panel.

   a. Individually number wiring conductors connected to terminal strips, and identify each cable or wiring group being extended from a panel or cabinet to a building-mounted device shall be identified with name and number of particular device as shown.
   b. Label each unit and field within distribution racks and frames.

3. Identification within Connector Fields in Equipment Rooms and Wiring Closets: Label each connector and each discrete unit of cable-terminating and connecting hardware.
4. Meet with the Owner’s Telecommunications personnel and coordinate labeling requirements prior to installation.

G. Labels shall be preprinted or computer-printed type with printing area and font color that contrasts with cable jacket color but still complies with requirements in TIA/EIA-606-A.

1. Cables use flexible vinyl or polyester that flex as cables are bent.

3.10 INSTALLATION

A. Equipment
1. Provide new equipment that shall meet or exceed the latest published specifications of the manufacturer in all respects as specified in the Equipment List on the drawings.
2. Supply the latest model, available at the time of bidding, of each piece of equipment.
3. Color of devices shall be reviewed and approved by the architect.

B. Speakers:
1. Maintain uniform polarity in speakers and wiring.
2. Employ no positive stop in rotation of speaker volume controls. Controls shall be capable of continuous rotations in either direction.
3. Neatly mount speaker grilles, panels, connector plates, control panels, etc., tight, plumb, and square unless indicated otherwise on drawings.
4. Provide adequate fastenings and supports with a safety load factor of at least three and adhere to all seismic requirements.

C. Equipment Cabinet:
1. Install vent panels at top and bottom of equipment cabinets and between components where possible for maximum ventilation. Locate amplifiers at top of cabinet. Locate digital signal processors below amplifiers, separated by several vent panels.
2. Securely fasten equipment plumb and square in place. Utilize all fastening holes in front of cabinet.
3. Securely fasten in place equipment that is not rack mounted, including relays and other small components. Do not use sticky-back tape.
4. Install balancing / isolation transformer when balanced and unbalanced components are connected.
5. Wire XLR-type connections with pin 2 hot, pin 1 shield.
6. Connect powered components to 120 VAC outlets on voltage suppressor power bars. Do not connect to outlets on other components.
7. Identification:
   a. Legibly identify user-operated system controls and system input / output jacks using engraved, permanently attached laminated plastic plates or imprinted Lexan labels. Label equipment and controls within equipment cabinets using similar labels or printed labels from a label maker or laser printer.
   b. Affix label to rack panel inside cabinet listing name and telephone number of installer. Appropriate warranty instructions may be included.

D. Cables:
1. Leave sufficient service loops of uniform length on cables to allow for future equipment replacement.
2. Make parallel connections or splices on standard barrier terminal blocks using spade lugs, or on equipment terminals using appropriate connection type. Do not attach more than three spade lugs under any one screw terminal.
3. Strip and heat shrink tubing on wires installed in Euro block or Phoenix connectors so 1/16 inch (2 mm) of wire is exposed outside connector when wire contacts back of connector:
   a. Secure wires using screwdriver with blade of same width as screw slot and handle 3/4 inch (19 mm) minimum diameter and of length to allow applying sufficient torque to prevent wires from becoming disconnected.
4. Terminate conductors with proper mating connectors:

a. Do not use adapters.
b. Use proper crimp tool as recommended by Connector Manufacturer.

5. Male CAT-6 connectors shall be grey-smoked or blue-smoked RJ-45's.
   a. After installing RJ-45 connectors, test CAT-6 cables for shorts, opens, and cross-pairing with two-piece wire-mapping continuity tester.
6. Secure cables to equipment cabinet with wire ties to ensure neat installation:
7. Ground both ends of each cable shielded within equipment cabinet only. Ground microphone cables only at mixer.
8. Label within 6" of both ends of cables with source and destination. Use Hellermann Tyton Tag 49L-105 or similar label types.
   a. Example 1: PULPIT MIC: MIXER IN 1.
   b. Example 2: DSP OUT B: CC1 AMP IN.
   c. Group all cables according to the signals being carried. In order to reduce signal contamination, form separate groups for the following cables:
      1) Microphone cables
      2) UTP, sound system control, telephone, video or ATC cables
      3) Loudspeaker cables
      4) Antenna cables
      5) Power cables at least a foot away from the above.
9. Install no cable with a bend radius less than that recommended by the cable manufacturer.
10. Grommets and other devices shall be used to insure the integrity of the cable now and in the future.
11. Bundle multiple cables in Tech Flex if in full view of the owner.
12. Use plenum rated cable tie-wraps and supports when conditions require it.
13. All cables shall be routed in conduit and cable tray. Size raceways in accordance with NEC conductor fill requirements.

E. Equipment installed in millwork shall be cut in with the upmost care and aesthetic value. Verify that adequate cooling for the electronics is sufficient.

F. Power cables shall be plugged into TVSS power strips and not into other electronics.

G. During installation if surfaces become damaged intentionally or unintentionally they shall be repaired in a professional manner.

3.11 FIELD QUALITY CONTROL

A. Field Tests:
   1. Installer Testing:
      a. After completion of installation but before inspection by Audio / Video Consultant, perform following:
         1) Conduct system tests and make necessary corrections for proper system operation including, but not limited to, following:
            a) Output level uniformity.
            b) Polarity.
            c) Shock, strain excited hum, and oscillation.
            d) Clipping, hum, noise, and RFI in all system configurations.
            e) Speaker line impedances.
            f) Loose parts and poor workmanship.
         2) Sweep speaker systems with high-level sine wave noise source. Correct causes of buzzes or rattles related to speakers or enclosures. Notify Contractor and Audio / Video Consultant of external causes of buzzes or rattles.
         3) Rough Balance: Balance system well enough that it can be used before final inspection.

b. Complete documentation and submit to consultant 5 days prior to Substantial Completion.
   1) Written notification with settings and as-built drawings.
   2) Electronic copy of Operation and Maintenance Manual.

B. Field Inspections:
   1. Audio / Video Consultant Inspection And Equalization:
      a. Coordinate final inspection schedule with Audio / Video Consultant two weeks minimum before Consultant's final inspection.
      b. Have copy of redlined record documents available 5 days prior to Substantial Completion.
      c. Have loose equipment (microphones, cables, etc.) available at time of inspection.
      d. Assist Audio / Video Consultant in final inspection of completed system.
      e. Provide following test equipment in good working order:
         1) Laptop computer, 100 MHz Pentium or better, with 16 bit sound card, software, and interfacing adapters for microprocessor controlled equipment in system.
         2) 1/3 octave real-time audio spectrum analyzer with SPL meter, and precision microphone.
         3) Digitally generated random pink noise generator, 20Hz-20KHz, minimum 2 hour repetition rate or 10 minutes minimum of equivalent signal recorded on compact disc.
         4) Direct reading audio impedance meter, minimum 3 frequencies, and 10 percent accuracy.
         5) Digital Volt-Ohmmeter.
         6) Audio oscillator, variable frequency, 20 Hz to 20 KHz.
         7) Compact disc player, or equal, with pre-recorded speech and music program material.
         8) Necessary chargers, cables, test leads, adapters, and other accessories for test equipment.
         9) Tools and spare parts for making adjustments and corrections to system.
         10) Blank cassette tape for testing cassette recorder.
         11) CAT-5 / RJ-45 continuity tester similar to Ideal 62-200 or Amprobe DCT-300.
      f. Correct minor items so Audio / Video Consultant may certify satisfactory completion during his visit.

3.12 SYSTEM ACCEPTANCE

A. System acceptance tests shall not be performed until the initial system checkout has been completed. The system acceptance tests shall be supervised by the Consultant and shall consist of the following:
   1. Take a physical inventory of all equipment on site and compare to equipment lists in the contract documents.
   2. Demonstrate the operation of all system equipment.
   3. Both subjective and objective tests will be required by the Consultant to determine compliance with the specifications. Provide test equipment specified by the Consultant for these tests.
   4. Provide all final, "as-built" drawings, manuals, video (DVD format) and other required documents.

B. In the event that the systems are not completely installed, or further adjustment is required, or defective equipment must be repaired or replaced, tests may be suspended or continued at the option of the Consultant. The Consultant’s return trip shall be paid for by the installer prior to the Consultants return.
   1. If the need for further adjustments becomes evident during the demonstration and testing, continue work until the installation operates properly. Included in the continued

work shall include, but not be limited to, changes to or installation of resistive pads, readjustment of loudspeaker aiming, adjustment of system equalizers, programming changes to the control system, if in the judgment of the Consultant, these adjustments are required.

2. If acceptance of the system is delayed because of defective equipment or because the equipment does not fulfill this specification, reimburse the Consultant for all time and expenses of the Consultant for these tests during any extensions of the acceptance-testing period.

3.13 CLEANUP AND REPAIR

A. Upon completion of the work, remove all refuse and rubbish from and about the premises daily, and shall leave the relevant areas and equipment clean and in an operational state. Repair any damage caused to the premises by the installation activities, at no cost to the Owner.

3.14 PROTECTION OF WORK

A. During the installation, and up to the date of final acceptance, protect finished and unfinished work against damage and loss. In the event of such damage or loss, replace or repair such work at no cost to the Owner.

3.15 OPERATIONS TRAINING

A. At the completion of the project, the contractor shall provide and implement a complete and comprehensive staff training program for all administrators, facility staff members, and teachers done on site. This mandatory training program will provide school staff a complete understanding of how to utilize and properly operate all functions. Two (2) complete and separate operations training programs shall be provided, one for classroom systems and the other for non-classroom systems.

B. At three (3) months from completion of the project, the contractor shall provide and implement a complete and comprehensive follow-up/refresher training program for all administrators, facility staff member, and teachers done on site. Two (2) complete and separate follow-up/refresher training programs shall be provided, one for classroom systems and the other for non-classroom systems.

C. The training program shall be conducted by certified factory trained implemented by a staff member/trainer employed by the contractor. The trainer must be factory certified to provide training on their product.

D. All staff development training is to be coordinated through the owner's designated representative. As training sessions are completed, the trainer will provide the school's administrative staff and school district's staff a document listing all of the staff and faculty members who attended, received, and completed the training program.

E. Video tape training and provide electronic file of video to the Owner.

F. Provide quick reference guides.

3.16 MAINTENANCE AND REPAIR TRAINING

A. The contractor shall provide and implement a complete and comprehensive training program for all maintenance personnel. Two (2) complete and separate operations training programs shall be provided, one for classroom systems and the other for non-classroom systems.

B. This mandatory training program will provide a complete understanding of how to maintain and repair the system including but not limited to:

1. Installation.
2. Wiring.
3. Programming.
4. Administration.
5. Trouble shooting/repair.
6. Product certification.

C. The training program shall be implemented by a factory trained certified technician on the school site. Six (6) maintenance personnel from the Owner shall be trained to a “certified” level and receive a certificate.

D. Additional Digital Signal Processor and Touch Screen Controls Training: In addition to the training described above, provide training for the digital signal processor and touch screen controls by a certified factory-trained technician who is employed directly by the factory. Include all costs in bid including, but not necessarily limited to airfare, hotels, meals, rental car, parking, gasoline, travel time, training time, etc. Six (6) maintenance personnel from the Owner shall be trained to a “certified” level and receive a certificate.

E. All training is to be coordinated through the owner’s designated representative. As training sessions are completed, the trainer will provide the school’s administrative staff and school district’s staff a document listing all of the maintenance personnel who attended, received, and completed the training program.

F. Provide quick reference guides.

END OF SECTION 27 51 15

Louisa May Alcott
Community School

SECTION 27 51 17 – VIDEO SYSTEMS

PART 1 - GENERAL

1.1 SUMMARY

A. Includes But Not Limited To:
   1. Furnish and install complete and operational sound systems as described in Contract Documents to include all equipment and materials, whether specifically mentioned herein or not, to ensure complete and operational systems.
   2. Assist Audio / Video Consultant with final inspection and equalization of system and provide necessary test equipment for sound system and partition noise isolation tests. Correct problems found at time of final inspection of system.

B. Related Requirements:
   1. Division 26:
      a. Raceways, boxes, and fittings.
   2. Audio / Video Consultant will perform final inspection, system balance, and equalization.

1.2 ADMINISTRATIVE REQUIREMENTS

A. Coordination:
   1. Coordinate final inspection schedule with Audio / Video Consultant three weeks minimum before Consultant's final inspection.

1.3 SUBMITTALS

A. Informational Submittals:
   1. Itemized list of equipment to be supplied with product data sheets
   2. Shop drawings
   3. System programming

B. Closeout Submittals:
   1. Include following in Operations And Maintenance Manual:
      a. Operations and Maintenance Data:
         1) Equipment Manufacturer's manual:
            a) Sound system operation and maintenance instructions.
            b) List of equipment provided, including portable equipment, showing make, model, and serial number.
      b. Warranty Documentation:
         1) Include copy of final, executed warranties.
         2) Contact information.
      c. Record Documentation:
         1) Software and Programming: Copies of all manufacturers' software used for programming various components and functions of the system shall be furnished to the Owner:
            a) Original source codes and compiled codes used for system control, audio setup and any other computerized functions of the system including screen layout generation, configuration and layouts and any other related computer files shall also be furnished to the Owner.
            b) In each and every case, all programming, code generation, configuration files, layout files and any other software and/or code written and generated of the setup and operation of this system are the property of the Owner of the system and not of the consultant, contractor or integrator.
         2) Testing results.

3) Hardware locations and configurations.

1.4 QUALITY ASSURANCE

A. Qualifications: Requirements is not limited to following:
1. Installers Qualifications:
a. Approved Installers. Specified installers are to both furnish and install components of sound system.
1) General Communications: (801) 266-5731.
2) Marshall Industries: (801) 266-2428.
3) Poll Sound: (801) 261-2500.
4) Summit Fire (801)295-1189
5) Bids submitted by non-pre-qualified bidders will not be accepted.
b. Installer's Qualifications:
1) The work of this section will be contracted to a single firm, referred to as the Sound Installer for undivided responsibility.
2) The Sound Installer must be experienced in the installation of professional sound systems and have completed within the past five years at least five sound system projects of a size and scope comparable to the project described herein.
3) The Sound Installer shall have capabilities and in-house facilities for installation, shop fabrication and repair service of professional sound systems.
4) The Sound Installer shall have on his full-time payroll at least one staff engineer having five years minimum experience as an Audio and Video engineer. In place of a qualified staff engineer, the Sound Installer may retain a consulting engineer to direct the project. Prior to bid acceptance, the qualifications of the consulting engineer shall be submitted for the approval of the Consultant. Said staff or consulting engineer shall:
5) Provide all technical liaisons between the Sound Installer and the Consultant.
6) Represent the Sound Installer at meetings and conferences, and be present at the job site for final inspection/
7) Be responsible for supervision of all technical and engineering work required executing the contract, and in particular, approving and signing of all shop drawings.
8) Must be a dealer or distributor of equipment included in bid and provide documents from manufacturers stating such.
9) Outline the general scope of past project, normal staffing levels, and union status of shop and field installation personnel.
10) List a minimum of three (3) projects of similar scope successfully completed, indicating the location, type of system installed, total contract amount, date completed, and include persons and telephone number to contact.
11) Submit confirmation of current state or local contracting licenses, as required to perform the work under this section.
2. Manufacturer's Qualifications:
a. Firms regularly engaged in manufacture of sound system components and accessories for more than 5 years.

1.5 EXTRA MATERIALS

A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents. Refer to drawings for descriptions and quantities of extra material required. Except for major head-end equipment, at least 3% spare materials but not less than one whole unit of each type of input or output device shall be provided whether indicated or not.

1.6 WARRANTY

A. Special Warranty:
   1. Provide complete warranty repair or replacement for one year at no cost to Owner, except in case of obvious abuse.
   2. Honor component warranties for term established by Manufacturer, if greater than one year.
   3. Activate all manufacturers' equipment warranties in Owner's name to commence on the date of acceptance.
   4. Contractor shall respond, excluding weekends and holidays, within 24 hours to any warranty service calls. If equipment cannot be repaired within 24 hours of service visit, the contractor shall provide "loaner" equipment to the facility at no charge. Response shall be defined as a visit to the site; a phone call is not acceptable. The response time of 24 hours is defined to mean one day, not three business days.
   5. If, during the warranty period, any component is out of service for more than one week due to unavailability of parts or service, supply and install an identical new component. If an identical component is not available, substitute equivalent equipment, but only with approval of the Owner.
   6. When equipment is removed from the school for warranty repair or replacement, provide documentation filed with the school including description of part, serial number, estimated return date of equipment, and technician contact information.

PART 2 - EXECUTION

2.1 SYSTEM DESCRIPTION

A. Products are specified on drawings.

PART 3 - EXECUTION

3.1 FIELD COOPERATION

A. Cooperate at all times, and to the fullest extent, with all trades during work to the end that lost time, work stoppages, interference, and inefficiencies do not occur.

3.2 SHOP DRAWINGS SUBMITTALS

A. Submit shop drawings of systems prior to fabrication:
   1. System functional block drawings including all equipment names and model numbers.
   2. Provide full scale drawings of all custom plates and panels indicating exact lettering, critical dimensions, and finish.
   3. Provide a list of test equipment, including manufacturer, description and model number of the test equipment expected to be employed in the test and adjustment of the systems.

3.3 EXAMINATION

A. Verification Of Conditions:
   1. Verify compliance with following items before beginning work of this Section.
      a. No cables spliced.
      b. Isolated grounds run back to electrical panel from all equipment cabinets.
      c. Specified conduit, cables, speaker enclosures and equipment cabinets are properly installed.
      d. Location and angle of speaker cabinets.

3.4 PRECONSTRUCTION MEETING: Attend a Preconstruction Meeting with the Owner to review installation standards prior to doing any work.

3.5 WIRING METHODS

A. Install cables in raceways and cable trays except within consoles, cabinets, desks, counters, and accessible lay-in tile accessible ceilings. Install cabling with horizontal and vertical cable guides in telecommunications spaces with terminating hardware and interconnection equipment. Where cables are routed in accessible lay-in tile suspended ceilings, secure and support cables with J-hooks a minimum of 8 inches (200 mm) above ceilings and not more than 60 inches (1524 mm) apart; cable shall not be run through structural members or in contact with pipes, ducts, or other potentially damaging items. Install cables in open ceilings (finished and unfinished) in raceways. Where raceways are installed in finished ceilings, paint raceways to match the color of the surrounding surface.

1. Install plenum cable in environmental air spaces, including plenum ceilings.
2. Comply with requirements in Section 260110 "Conduit Raceways." Minimum raceway size is 3/4".
3. Comply with requirements in Section 260111 "Cable Trays."

B. Wiring within Enclosures:

1. Bundle, lace, and train conductors to terminal points with no excess and without exceeding manufacturer's limitations on bending radii.
2. Install lacing bars and distribution spools.
3. Install conductors parallel with or at right angles to sides and back of enclosure.

3.6 INSTALLATION OF CABLES

A. Comply with NECA 1.

B. General Requirements for Cabling:

1. Comply with TIA/EIA-568-B.1.
2. Comply with BICSI ITSIM, Ch. 6, "Cable Termination Practices."
3. Make terminations only at indicated outlets, terminals, cross-connects, and patch panels.
4. Cables may not be spliced. Secure and support cables at intervals not exceeding 30 inches (760 mm) and not more than 6 inches (150 mm) from cabinets, boxes, fittings, outlets, racks, frames, and terminals.
5. Install lacing bars to restrain cables, to prevent straining connections, and to prevent bending cables to smaller radii than minimums recommended by manufacturer.
6. Bundle, lace, and train conductors to terminal points without exceeding manufacturer's limitations on bending radii, but not less than radii specified in BICSI ITSIM, "Cabling Termination Practices" Chapter. Install lacing bars and distribution spools.
7. Do not install bruised, kinked, scored, deformed, or abraded cable. Do not splice cable between termination, tap, or junction points. Remove and discard cable if damaged during installation and replace it with new cable.
8. Cold-Weather Installation: Bring cable to room temperature before de-reeling. Heat lamps shall not be used for heating.
9. In the communications equipment room, install a 10-foot- (3-m-) long service loop on each end of cable.
10. Pulling Cable: Comply with BICSI ITSIM, Ch. 4, "Pulling Cable." Monitor cable pull tensions.

C. UTP Cable Installation:

1. Comply with TIA/EIA-568-B.2.
2. Do not untwist UTP cables more than 1/2 inch (12 mm) from the point of termination to maintain cable geometry.

D. Group connecting hardware for cables into separate logical fields.

E. Separation from EMI Sources:

1. Comply with BICSI TDMM and TIA-569-B for separating unshielded copper voice and data communication cable from potential EMI sources, including electrical power lines and equipment.
2. Separation between open communications cables or cables in nonmetallic raceways and unshielded power conductors and electrical equipment shall be as follows:

   a. Electrical Equipment Rating Less Than 2 kVA: A minimum of 5 inches (127 mm).
   b. Electrical Equipment Rating between 2 and 5 kVA: A minimum of 12 inches (300 mm).
   c. Electrical Equipment Rating More Than 5 kVA: A minimum of 24 inches (610 mm).

3. Separation between communications cables in grounded metallic raceways and unshielded power lines or electrical equipment shall be as follows:

   a. Electrical Equipment Rating Less Than 2 kVA: A minimum of 2-1/2 inches (64 mm).
   b. Electrical Equipment Rating between 2 and 5 kVA: A minimum of 6 inches (150 mm).
   c. Electrical Equipment Rating More Than 5 kVA: A minimum of 12 inches (300 mm).

4. Separation between communications cables in grounded metallic raceways and power lines and electrical equipment located in grounded metallic conduits or enclosures shall be as follows:

   a. Electrical Equipment Rating Less Than 2 kVA: No requirement.
   b. Electrical Equipment Rating between 2 and 5 kVA: A minimum of 3 inches (76 mm).
   c. Electrical Equipment Rating More Than 5 kVA: A minimum of 6 inches (150 mm).

5. Separation between Communications Cables and Electrical Motors and Transformers, 5 kVA or HP and Larger: A minimum of 48 inches (1200 mm).
6. Separation between Communications Cables and Fluorescent Fixtures: A minimum of 5 inches (127 mm).

3.7 FIRESTOPPING

A. Comply with requirements in Section 078413 "Penetration Firestopping."

B. Comply with TIA-569-B, Annex A, "Firestopping."

C. Comply with BICSI TDMM, "Firestopping Systems" Article.

3.8 GROUNDING

A. Install grounding according to BICSI TDMM, "Grounding, Bonding, and Electrical Protection" Chapter.

B. Comply with J-STD-607-A.

C. Locate grounding bus bar to minimize the length of bonding conductors. Fasten to wall allowing at least 2-inch (50-mm) clearance behind the grounding bus bar. Connect grounding bus bar with a minimum No. 4 AWG grounding electrode conductor from grounding bus bar to suitable electrical building ground.

D. Bond metallic equipment to the grounding bus bar, using not smaller than No. 6 AWG equipment grounding conductor.

3.9 IDENTIFICATION

A. Identify system components, wiring, and cabling complying with TIA/EIA-606-A. Comply with requirements for identification specified in Section 260553 "Identification for Electrical Systems."

1. Administration Class: 2.
2. Color-code cross-connect fields. Apply colors to voice and data service backboards, connections, covers, and labels.

B. Comply with requirements in Section 099123 "Interior Painting" for painting backboards. For fire-resistant plywood, do not paint over manufacturer's label.

C. Paint and label colors for equipment identification shall comply with TIA/EIA-606-A for Class 2 level of administration, including optional identification requirements of this standard.

D. Cable Schedule: Post in prominent location in each equipment room and wiring closet. List incoming and outgoing cables and their designations, origins, and destinations. Protect with rigid frame and clear plastic cover. Furnish an electronic copy of final comprehensive schedules for Project.

E. Cabling Administration Drawings: Show building floor plans with cabling administration-point labeling. Identify labeling convention and show labels for telecommunications closets, backbone pathways and cables, entrance pathways and cables, terminal hardware and positions, horizontal cables, work areas and workstation terminal positions, grounding buses and pathways, and equipment grounding conductors. Follow convention of TIA/EIA-606-A. Furnish electronic record of all drawings, in software and format selected by Owner. Provide three (3) hard copies to owner. Provide one (1) drawing in each equipment room and wiring closet and post in a prominent location. Protect with rigid frame and clear plastic cover.

F. Cable and Wire Identification:

1. Label each cable within 4 inches (100 mm) of each termination and tap, where it is accessible in a cabinet or junction or outlet box, and elsewhere as indicated.
2. Label each terminal strip and screw terminal in each cabinet, rack, or panel.

   a. Individually number wiring conductors connected to terminal strips, and identify each cable or wiring group being extended from a panel or cabinet to a building-mounted device shall be identified with name and number of particular device as shown.
   b. Label each unit and field within distribution racks and frames.

3. Identification within Connector Fields in Equipment Rooms and Wiring Closets: Label each connector and each discrete unit of cable-terminating and connecting hardware.
4. Meet with the Owner's Telecommunications personnel and coordinate labeling requirements prior to installation.

G. Labels shall be preprinted or computer-printed type with printing area and font color that contrasts with cable jacket color but still complies with requirements in TIA/EIA-606-A.

1. Cables use flexible vinyl or polyester that flex as cables are bent.

3.10 INSTALLATION

A. Equipment
1. Provide new equipment that shall meet or exceed the latest published specifications of the manufacturer in all respects as specified in the Equipment List on the drawings.
2. Supply the latest model, available at the time of bidding, of each piece of equipment.
3. Color of devices shall be reviewed and approved by the architect.

B. Equipment Cabinet:
1. Install vent panels at top and bottom of equipment cabinets and between components where possible for maximum ventilation. Locate amplifiers at top of cabinet. Locate digital signal processors below amplifiers, separated by several vent panels.
2. Securely fasten equipment plumb and square in place. Utilize all fastening holes in front of cabinet.
3. Securely fasten in place equipment that is not rack mounted, including relays and other small components. Do not use sticky-back tape.
4. Install balancing / isolation transformer when balanced and unbalanced components are connected.
5. Connect powered components to 120 VAC outlets on voltage suppressor power bars. Do not connect to outlets on other components.
6. Identification:
   a. Legibly identify user-operated system controls and system input / output jacks using engraved, permanently attached laminated plastic plates or imprinted Lexan labels. Label equipment and controls within equipment cabinets using similar labels or printed labels from a label maker or laser printer.
   b. Affix label to rack panel inside cabinet listing name and telephone number of installer. Appropriate warranty instructions may be included.

C. Cables:
1. Leave sufficient service loops of uniform length on cables to allow for future equipment replacement.
2. Terminate conductors with proper mating connectors:
   a. Do not use adapters.
   b. Use proper crimp tool as recommended by Connector Manufacturer.
3. Secure cables to equipment cabinet with wire ties to ensure neat installation:
4. Label within 6" of both ends of cables with source and destination. Use Hellermann Tyton Tag 49L-105 or similar label types.
   a. Group all cables according to the signals being carried. In order to reduce signal contamination, form separate groups for the following cables:
      1) Microphone cables
      2) UTP, sound system control, telephone, video or ATC cables
      3) Loudspeaker cables
      4) Antenna cables
      5) Power cables at least a foot away from the above.
5. Install no cable with a bend radius less than that recommended by the cable manufacturer.

6. Grommets and other devices shall be used to insure the integrity of the cable now and in the future.
7. Bundle multiple cables in Tech Flex if in full view of the owner.
8. Use plenum rated cable tie-wraps and supports when conditions require it.
9. Cable shall be routed in raceway and cable tray. Size raceway in accordance with all NEC conductors fill requirements.

D. Equipment installed in millwork shall be cut in with the upmost care and aesthetic value. Verify that adequate cooling for the electronics is sufficient.

E. Power cables shall be plugged into TVSS power strips and not into other electronics.

F. During installation if surfaces become damaged intentionally or unintentionally they shall be repaired in a professional manner.

3.11 FIELD QUALITY CONTROL

A. Field Tests:
   1. Installer Testing:
      a. After completion of installation but before inspection by Audio / Video Consultant, perform following:
         1) Conduct system tests and make necessary corrections for proper system operation including, but not limited to, following:
            a) Output level uniformity.
            b) Polarity.
            c) Shock, strain excited hum, and oscillation.
            d) Clipping, hum, noise, and RFI in all system configurations.
            e) Loose parts and poor workmanship.
         2) Rough Balance: Balance system well enough that it can be used before final inspection.
      b. Complete documentation and submit to consultant 5 days prior to Substantial Completion.
         1) Written notification with settings and as-built drawings.
         2) Electronic copy of Operation and Maintenance Manual.

B. Field Inspections:
   1. Audio / Video Consultant Inspection And Equalization:
      a. Coordinate final inspection schedule with Audio / Video Consultant two weeks minimum before Consultant's final inspection.
      b. Have copy of redlined record documents available 5 days prior to Substantial Completion.
      c. Have loose equipment (microphones, cables, etc.) available at time of inspection.
      d. Assist Audio / Video Consultant in final inspection of completed system.
      e. Provide following test equipment in good working order:
         1) Field strength
         2) Video test signal generator
         3) Blu Ray and DVD with pre-recorded speech and music program material.
         4) Necessary chargers, cables, test leads, adapters, and other accessories for test equipment.
         5) Tools and spare parts for making adjustments and corrections to system.
      f. Correct minor items so Audio / Video Consultant may certify satisfactory completion during his visit.

3.12 SYSTEM ACCEPTANCE

A. System acceptance tests shall not be performed until the initial system checkout has been completed. The system acceptance tests shall be supervised by the Consultant and shall consist of the following:
   1. Take a physical inventory of all equipment on site and compare to equipment lists in the contract documents.
   2. Demonstrate the operation of all system equipment.
   3. Both subjective and objective tests will be required by the Consultant to determine compliance with the specifications. Provide test equipment specified by the Consultant for these tests.
   4. Provide all final, "as-built" drawings, manuals, video (DVD format) and other required documents.

B. In the event that the systems are not completely installed or further adjustment is required, or defective equipment must be repaired or replaced, tests may be suspended or continued at the option of the Consultant. The Consultant's return trip shall be paid for by the installer prior to the Consultants return.
   1. If the need for further adjustments becomes evident during the demonstration and testing, continue work until the installation operates properly. Included in the continued work shall include, but not be limited to, changes to or installation of resistive pads, readjustment of loudspeaker aiming, adjustment of system equalizers, programming changes to the control system, if in the judgment of the Consultant, these adjustments are required.
   2. If acceptance of the system is delayed because of defective equipment or because the equipment does not fulfill this specification, reimburse the Consultant for all time and expenses of the Consultant for these tests during any extensions of the acceptance-testing period.

3.13 CLEANUP AND REPAIR

A. Upon completion of the work, remove all refuse and rubbish from and about the premises daily, and shall leave the relevant areas and equipment clean and in an operational state. Repair any damage caused to the premises by the installation activities, at no cost to the Owner.

3.14 PROTECTION OF WORK

A. During the installation, and up to the date of final acceptance, protect finished and unfinished work against damage and loss. In the event of such damage or loss, replace or repair such work at no cost to the Owner.

3.15 OPERATIONS TRAINING

A. At the completion of the project, the contractor shall provide and implement a complete and comprehensive staff training program for all administrators, facility staff members, and teachers done on site. This mandatory training program will provide school staff a complete understanding of how to utilize and properly operate all functions. Two (2) complete and separate operations training programs shall be provided, one for classroom systems and the other for non-classroom systems.

B. At three (3) months from completion of the project, the contractor shall provide and implement a complete and comprehensive follow-up/refresher training program for all administrators, facility staff member, and teachers done on site. Two (2) complete and separate follow-up/refresher training programs shall be provided, one for classroom systems and the other for non-classroom systems.

C. The training program shall be implemented by a staff member/trainer employed by the contractor. The trainer must be factory certified to provide training on their product.

D. All staff development training is to be coordinated through the owner's designated representative. As training sessions are completed, the trainer will provide the school's administrative staff and school district's staff a document listing all of the staff and faculty members who attended, received, and completed the training program.

E. Video tape training and provide electronic file of video to the Owner.

F. Provide quick reference guides.

3.16 MAINTENANCE AND REPAIR TRAINING

A. The contractor shall provide and implement a complete and comprehensive training program for all maintenance personnel. Two (2) complete and separate operations training programs shall be provided, one for classroom systems and the other for non-classroom systems.

B. This mandatory training program will provide a complete understanding of how to maintain and repair the system including but not limited to:

1. Installation.
2. Wiring.
3. Programming.
4. Administration.
5. Trouble shooting/repair.
6. Product certification.

C. The training program shall be implemented by a factory trained certified technician on the school site. Two (2) maintenance personnel from the Owner shall be trained to a "certified" level and receive a certificate.

D. Additional Digital Signal Processor and Touch Screen Controls Training: In addition to the training described above, provide training for the digital signal processor and touch screen controls by a certified factory-trained technician who is employed directly by the factory. Include all costs in bid including, but not necessarily limited to airfare, hotels, meals, rental car, parking, gasoline, travel time, training time, etc. Six (6) maintenance personnel from the Owner shall be trained to a "certified" level and receive a certificate.

E. All training is to be coordinated through the owner's designated representative. As training sessions are completed, the trainer will provide the school's administrative staff and school district's staff a document listing all of the maintenance personnel who attended, received, and completed the training program.

F. Provide quick reference guides.

END OF SECTION 27 51 17

Louisa May Alcott
Community School

SECTION 27 51 23 – EDUCATIONAL INTERCOMMUNICATION AND PROGRAM SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

1. The drawings and general provisions of the Contract Documents apply to this Section.

1.2 SUMMARY

A. This section includes a fully operational IP platform for district and school internal communications system incorporating school safety notifications and general communications including but not limited to the following:

1. The platform shall provide complete internal communications employing state of the art IP Technology including the minimum functions listed.
   a. Two-way Loud Speaking Internal Intercommunications.
   b. Bell Event announcement
   c. Emergency announcement that will override any pre-programmed zones assuring that all Emergency/Lockdown etc., are heard at each and every speaker location.
   d. Capability of prerecording emergency announcements that can simply be activated by a simple Soft Key or via a dedicated call-switch.
   e. Atomic Time Synchronization with Class Change Tones utilizing multiple, programmable schedules for each zone.
   f. District wide, Emergency, All and zone live voice paging
   g. District wide, emergency, all and zone paging for pre-recorded audio – tones, music and voice.
   h. Web-based, permission driven user interface.
2. The system shall support a minimum of 1000 level priorities which shall be user definable, allowing each end point to place a minimum of 5 different priority calls at the same time.
3. Any authorized administrator shall be able to call from outside the school into any classroom, zone or entire school directly via the School District supplied SIP enabled Telephone Network. This shall allow remote monitoring, call-in annunciation and two-way conversation from outside the facility as well as paging into the system. (Compliance with NEMA Standard SB-40 for emergency communications in K-12 Schools)
4. Authorized system users shall be able to create a minimum of twenty (20) automated sequences with emergency instructions, emails and relay activations and replay them. Automated message strings shall be, manually played from a single-button access on the console, on a SIP connected telephone, a panic button or from the web interface.
5. Paging and two-way loud speaking features shall be accessible from any system console or SIP connected telephone.
6. The platform shall synchronize its system time to the network timeserver or a web-based time server.
7. Each single school installation shall be locally survivable for intercom, paging bells, and emergencies such as lockdown, even when the district connection is unavailable.

8. This specification establishes a minimum level of quality, features, and performance for individual components as well as the integrated system.

1.3 DEFINITION OF TERMS

A. Installer(s): Shall refer to the person, persons, or company who or which actually contracts to perform the work specified herein.

1.4 SUBMITTALS

A. Product data for each component.

B. Shop Drawings: Prior to proceeding with the work: Provide detailed equipment assemblies and indicate dimensions, weights, required clearances, method of field assembly, components, and location of each field connection, and a complete schedule of all equipment and materials with associated manufacturers cuts sheets which are to be used.

1. Wiring Diagrams: Detail wiring for power, signal, and control systems and differentiate between manufacturer-installed and field-installed wiring. Identify terminals to facilitate installation, operation, and maintenance. Include a single-line diagram showing cabling interconnection of components and levels throughout system.
2. Artwork drawings and lists indicating proposed nameplate nomenclature and arrangements for control panels and plug panels prior to fabrication reflecting equipment used.
3. Each drawing shall have a descriptive title and all sub-parts of each drawing shall be labeled. All drawings shall have the name and locations of the project, Systems Contractor's name in the title block.
4. Details and descriptions of any other aspect of the system, which must differ from the contract documents due to field conditions or equipment, furnished.

C. Product Certificates: Signed by manufacturers of equipment certifying that products furnished comply with specified requirements.

D. Installer Certificates: Signed by manufacturer certifying that installers comply with requirements.

E. Manufacturer Certificates: Signed by manufacturers certifying that they comply with requirements.

F. Field Test Reports: Indicate and interpret test results for compliance with performance requirements. Include record of final matching transformer-tap settings, and signal ground-resistance measurement certified by Installer.

G. Maintenance Data: For equipment to be included in maintenance manuals specified in Division 1.

1. Record of Owners equipment-programming option decision.
2. All instructions necessary for proper operation and manufacturer's instructions.
3. "Proof of Performance" information.
4. Manufacturer's maintenance information.

5. Copies of non-proprietary computer programs and system set up disks documenting all programmable features of the installed system.

H. Record Drawings: Prior to final acceptance, provide three (3) complete sets of drawings indicating all cable numbers and construction details in accordance with the actual system installation. Revise all shop drawings to represent actual installation conditions. These Record Drawings will be used during "Final Acceptance Testing". Record drawings as a minimum shall include the following:

1. Testing results.
2. Hardware locations and configurations.
3. Software Configuration:
   a. Settings.
   b. Zoning.
   c. Users.
4. Warranty information and contacts.
5. Quick reference guide.

I. System Training: Submit the following information describing the training programs and system trainers as outlined in paragraph 1.6 of this specification and in accordance with Division 1 specifications.

1. Include with the submittal a preliminary staff development training program in outline form for review and approval by the owner's representative.
2. Include with the submittal a current copy of the trainer's certification from the manufacturer that certifies and identifies the trainer(s) who are eligible to provide training and support for the project.
3. Include with the submittal a current copy of trainer's need's assessment form which will be reviewed with the owner's designated representative for the system's preliminary system programming and configuration.
4. Include with the submittal copies of all documentation used to identify for the owner those participants attending and completing the training programs.

J. A copy of the manufacturer's standard statement of warranty proving all equipment provided for the school communications network is covered with the required five-year warranty shall be included with the project submittal. This statement of warranty shall be provided on the manufacturer's stationary.

1.5 QUALITY ASSURANCE

A. Installer Qualifications: An experienced installer who is an authorized representative of equipment manufacturer for both installation and maintenance of equipment required for this Section. Provide the following with in thirty (30) days after notification to proceed:

1. Provide a list of installations that the Installer has specifically installed for verification by the Owner. Random installations from other vendors and/or Installers shall not be accepted. The Installer, not its employees, must meet these qualifications.
2. The Installer shall be bondable.
3. The Installer shall demonstrate to the satisfaction of the Owner or his representative that he has:
   a. Adequate plant and equipment to pursue the work properly and expeditiously.

b. Adequate staff and technical experience to implement the work.
c. Suitable financial status to meet the obligations of the work.
d. Technically capable and factory trained service personnel at a local service facility to provide routine and emergency service for all products used in this project.

B. Any Contractor, who intends to bid on this work and does not meet the requirements of the "Quality Assurance" paragraph(s), shall employ the services of a "Installer" who does meet the requirements and who shall provide the equipment, make all connections and continuously supervise the installation. A subcontractor so employed as the "Installer" must be acceptable to the Architect/ Engineer. The "Installer" shall be identified within thirty (30) days of notification to proceed for acceptance by the Architect/Engineer

C. Because the life expectancy of this type of communications system normally exceeds ten years, the owner expects continuity from the service provider. If the installing/servicing company has not been an authorized provider of the manufacturer's product for it least ten years, the following is required:

1. A list of (2) systems manufacturers of which they currently are authorized service providers where the relationship exceeds five years
2. A letter from the manufacturer outlining the details of changes in service providers over the last five years and what actions they will take to ensure continuity in service to the customer.

D. Each major component of equipment shall have the manufacturers name, address and model number on a plate securely affixed in a conspicuous place. NEMA code ratings, UL Label, or other data that is die-stamped into the surface of the equipment shall be easily visible.

E. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction.

F. Comply with NFPA 70

G. Comply with NEMA Standard SB-40 for Emergency Communications in K-12 schools. .

H. Comply with UL 60950.

1.6 OPERATIONS TRAINING

A. At the completion of the project, the contractor shall provide and implement a complete and comprehensive staff training program for at least six (6) school personnel performed on site. This mandatory training program will provide school personnel a complete understanding of how to utilize and properly operate all functions.

B. At three (3) months after completion, the contractor shall provide and implement a follow-up / refresher training program for at least size (6) school personnel on site.

C. Both the training at completion and the training at three (3) months after completion shall be implemented by a factory trained certified technician who is a direct employee of the manufacturer; factory trained certified technicians from the local sales agency / integrator are not acceptable. Include all associated costs including, but not necessarily limited to air fare, hotels, meals, rental car, parking, travel time, training time, etc.

D. All staff development training is to be coordinated through the owner's designated representative. As training sessions are completed, the trainer will provide the school's

personnel a document listing all of the staff and faculty members who attended, received, and completed the training program.

E. Record a video of both training sessions and provide electronic file of the videos to the Owner.

1.7 MAINTENANCE AND REPAIR TRAINING

A. At the completion of the project, the contractor shall provide and implement a complete and comprehensive training program for all maintenance personnel. This mandatory training program will provide a complete understanding of how to maintain and repair the system.

B. The training program shall be implemented by a factory trained certified technician on the school site. Two (2) maintenance personnel from the Owner shall be trained to a “certified” level and receive a certificate. The factory trained certified technician shall be a direct employee of the manufacturer; factory trained certified technicians from the local sales agency / integrator are not acceptable. Include all associated costs including, but not necessarily limited to air fare, hotels, meals, rental car, parking, travel time, training time, etc. The training shall include:

1. Installation.
2. Wiring.
3. Programming.
4. Administration.
5. Trouble shooting/repair.
6. Product certification.

C. All training is to be coordinated through the owner’s designated representative. As training sessions are completed, the trainer will provide the school’s administrative staff and school district’s staff a document listing all of the maintenance personnel who attended, received, and completed the training program.

1.8 WARRANTY

A. Provide a manufacturer’s five-year warranty of the school communications network equipment against defects in material and workmanship. This warranty will cover all electronic equipment, as well as analog clocks, speakers, and call-in switches. If any defects are found within the warranty period, the defective equipment shall be replaced at no cost (equipment only); a one year warranty shall be provided for labor.

B. A copy of the manufacturer’s standard statement of warranty proving all equipment provided for the school communications network is covered with the required five-year warranty shall be included with the project submittal. This statement of warranty shall be provided on the manufacturer’s stationary. The standard five-year warranty is an important element in establishing a standard in quality. Manufacturers who circumvent the five-year warranty by offering special “extended warranties” that are not part of their normal published warranty will not be accepted.

C. Contractor shall respond, excluding weekends and holidays, within 24 hours to any warranty service calls. If equipment cannot be repaired within 24 hours of service visit, the contractor shall provide “loaner” equipment to the facility at no charge. Response shall be defined as a visit to the site; a phone call is not acceptable. The response time of 24 hours is defined to mean one day, not three business days.

D. Make available a service contract offering continuing factory authorized service of the system after the initial warranty period.

1.9 FULL ADMINSTRATIVE ACCESS

A. Full administrative access shall be given to School Personnel, IT, Utility Services, and Telecom.

1.10 EXTRA MATERIALS

A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents. Refer to drawings for descriptions and quantities of extra material required. Except for major head-end equipment, at least 3% spare materials but not less than one whole unit of each type of input or output device shall be provided whether indicated or not.

1.11 MANUFACTURERS

A. Basis-of-Design Product: Subject to compliance with requirements, provide Telecenter manufactured by Rauland-Borg Corp through Marshall Industries, Inc., 3800 W. 2100 S., Salt Lake City, UT 84120 or comparable products as may be approved by addendum.

1.12 BIDDING REQUIREMENTS

A. Integrator bidding Educational Intercommunication and Program Systems shall break out the costs of Audio Systems, Video Systems, Projection Screens, and Voice Lift Systems (if they approved to bid these systems). Failure to conform to this requirement, may be grounds for disqualification.

PART 2 - PRODUCTS

2.1 SYSTEM REQUIREMENTS

A. The platform shall utilize state of the art IP Technology, Call-in Notification, School Safety Paging and Evacuation tones, IP infrastructure, Atomic Time Synchronization with Class Change Tones utilizing multiple, programmable schedules for each zone, Two-way hands-free Internal Intercommunications and Paging, and Program Distribution. The system shall be easy to learn and operate. All standard programming shall be web based and user friendly to allow the system administrator the ability to easily program system features.

B. Provide complete and satisfactorily operating district/school communications and district/school safety as described herein, using materials and equipment of types, sizes, ratings, and performances as indicated. Use materials and equipment that comply with referenced standards and manufacturers' standard design and construction, in accordance with published product information. Coordinate the features of all materials and equipment so they form an integrated system, with components and interconnections matched for optimum performance of specified functions.

C. The platform shall be a single electronic system consisting of a minimum of 10 intercom channels per facility, (classroom) IP speakers, corridor speakers, inside and outside horns, call-

in switches, SIP phone integration, and district wide integration for paging, emergency notifications, and configuration.

D. The platform shall lend itself to expansion by simple addition of hardware modules.

E. The platform shall directly connect to the WAN/LAN without the need for a separate server at each school location. Configuration, including bell schedules, calendars, and emergency sequences can remotely be created, changed, stored and downloaded to the system by an authorized user from a browser-based interface.

F. The platform shall provide the ability to initiate school safety paging announcements, evacuation tones and take cover tones from any telephone within the facility or outside the facility to any other location within the facility or district.

G. The platform shall provide the ability to selectively communicate or monitor individual classrooms in emergency situations from any telephone within the facility or outside the facility to any other location within the facility; all communication within the classroom shall be hands free and will not require any interaction by the classroom user.

H. IP addressable speaker modules for individual rooms shall be system programmable and may be assigned any two, three, four, five or six digit number as well as name and description. Any extension may be reassigned at any time.

I. IP-enabled two-way voice communication shall be available from any provided telephone or administrative console through any speaker in the system. This shall allow hands-free communication to any classroom or any individual loudspeaker unit. A programmable pre-announce tone shall sound immediately before the intercom path is opened and a supervisory tone shall continue to sound at regular intervals when speaker monitoring is active, complying fully with all privacy legislation. Pre announce tone and supervisory tones shall be disabled during designated emergencies automatically.

J. Integrated Master Clock with unlimited schedules, unlimited events, and automatic Daylight Savings time correct. Up to 5 schedules may be active on any given day for each school. User shall be able to select from 25 standard included tones or unlimited user created and uploaded audio files for class change signaling and messaging. In addition, scheduled events shall include relay actions and email notifications. The platform shall allow control of the bell schedules via the district WAN/LAN without the need for a separate computer at the school location. Bell schedules can remotely be created, changed, stored and downloaded to the system by an authorized user from a browser-based interface.

K. Integration with existing intercom system. During multi-phase construction, the new communications system shall maintain class change signaling and zone paging across the building. A SIP gateway may be needed to integrate the new communications system with the existing Rauland Telecenter V.

2.2 EQUIPMENT AND MATERIAL

A. Server Software TCUSWENT2G

1. Provides district wide paging, bell event scheduling, emergency notification and configuration for entire district.
2. Reports on feature usage, system activity, etc. shall be available from the district-wide web interface.

3. Ability to perform configure system and initiate system features via district wide web based interface.
4. The software has the ability to sync system time to the Atomic Clock Signal or to the school's or districts network time server
5. The software will provide a web-browser to deliver district wide emergency paging, pre-recorded messages and tones from any authorized computer in the facility or the district. The software must be capable of automatically notifying district personnel via the WAN of an alarm condition.
6. The software can automatically broadcast page emergency instructions via associated system hardware throughout an entire district when an alarm (e.g. lockdown, lockout, security, fire) is initiated via the web-based interface. The emergency instructions are preprogrammed and require no user intervention. The system provides redundant alarm annunciation over intercom/paging speakers and is not meant to replace primary fire alarm or security systems
7. The software shall support VoIP Telecenter Campus Controllers for a minimum of 1000 facilities.
8. The software shall support a minimum of 50,000 IP Speaker modules, district wide.

B. VoIP Single Campus Controller Rauland-Borg Telecenter Series TCC2000 with the following features and capabilities:

1. Provides call routing for paging and intercom for a single facility
2. System shall connect to the district provided Telephone Network via a SIP connection.
3. The VX Works based Operating System and system programming database shall be stored in non-volatile flash memory. The Operating System can be easily upgraded through configuration without requiring replacement of any chips.
4. Support a flexible numbering plan allowing two, three, four, five, or six digit extensions.
5. SIP interface to a district provided Telephone Network shall be capable of allowing connected phones to display classroom call-ins, answer internal intercom call-ins, make pages and change priorities of call-ins in progress.
6. Direct Dialing, two-way amplified voice intercom between any provided telephone or admin console and speaker without the use of a press-to-talk or talk-listen switch.
7. Ability to place up to 5 levels of call-in from any call in switch per area.
8. The ability to answer intercom call-ins registered at pre-selected telephones.
9. The ability to automatically escalate incoming call-ins to an alternate administrative console or SIP telephone or group of telephones if they remain unanswered for a predetermined amount of time.
10. The ability to remotely locate IP Campus Controller. The controller shall not need direct connection to any classroom via home run or distributed wiring. It shall communicate solely through the IP LAN network.
11. Single button access from any telephone on the system to distribute emergency announcements within the facility to all or select locations equipped with speakers. Emergency announcements originating from any assigned administrative telephone shall have priority over all regular system functions.
12. Store a minimum of 48 hours of Bell Event Schedules, all emergency notification sequences as well as facility wide configuration.

13. System has the ability to sync system time to the Atomic Clock Signal or to the school's or districts network time server.

14. System's SIP Interface shall provide:
    a. Audio paging access from any telephone to any single intercom speaker, zone (group) of intercom/paging speakers, or all speakers/paging horns throughout the entire facility.
    b. Single button access from any telephone on the system to initiate alarm signals within the facility to all or select locations equipped with speakers. A minimum of 25 separate distinct alarm signals shall be provided. Alarm signals originating from any assigned administrative telephone shall have priority over all regular system functions.

15. The system will have the ability to utilize a web-browser and USB microphone to deliver district wide live emergency paging, pre-recorded messages and tones from any authorized computer in the facility or the district. The system must be capable of automatically notifying district personnel via the WAN of an alarm condition.

16. The system can automatically broadcast page emergency instructions throughout an entire school when an alarm (e.g. lockdown, lockout, security, fire) is tripped or manually activated. The emergency instructions are preprogrammed and require no user intervention. The system provides redundant alarm annunciation over intercom/paging speakers and is not meant to replace primary fire alarm or security systems.

C. IP addressable Modules TCC2011:

1. System shall provide multiple IP addressable modules for intercom, paging and relay activation.
    a. All modules are POE 802.3af compliant
    b. All Modules support DHCP
    c. All Modules connect to network with a single RJ45 connector

2. IP Speaker Module shall interface to school's data network, a speaker, and multiple call switches.
    a. A minimum of 5 levels of call-in can be placed from an IP Speaker Module. The call-ins route to designated administrative consoles and select SIP connected telephones and can only be cleared from the system once answered. If a call-in is not answered within a preprogrammed time the call-in may reroute to other telephones and consoles, and announce over selected or all speakers and.
    b. An option for Privacy call-in switches is supported. When the Privacy switch is activated it prevents administrative or classroom telephones from monitoring the specific classroom/location intercom speaker.
    c. The ability to belong to one or more of a minimum of 100 independent zones for zone paging, program/music distribution zones and class change tone reception; this assignment is a programmable function, change able by time of day. Each IP Speaker Modules location shall be programmed in software to belong to any combination of software zones. Software/hardwired zones must be configured as part of an unlimited number of district wide groups for school district emergency announcements. These district announcements must be accessed via microphone, a web-browser or telephone.
    d. IP Speaker Modules shall be designed to mount near ceiling and wall speakers and in the plenum space.

3. IP-addressable Zone Paging Module TCC2022:
    a. Zone paging module shall connect multiple speakers for district all page, all page, zone paging, bells, audio events and, emergency notification.
    b. Zone Paging Modules shall be rack and wall mountable.

c. Zone Paging modules shall be able to belong to one or more of 50 independent zones for live paging, bells, pre-recorded audio and emergency notification

4. IP Addressable Aux I/O Module TCC2033:
   a. Aux I/O Module shall have two input contacts and two output contacts.
   b. Input and output contacts are individually addressable.
   c. Aux I/O Module shall be wall and rack mountable.
      User can program relays to be activated manually, through an event/bell schedule and during emergency notification

D. IP Addressable Administrative Console TCC2044:

1. A full color screen with 4 soft keys, 3 line select, volume control, push to talk, speakerphone mode and left/right and up/down scrolling.
2. Audio paging access from any Console to any single intercom speaker, zone (group) of intercom/paging speakers, or all speakers/paging horns throughout the entire school.
3. Programmable soft key access from any console on the system to initiate alarm signals within the school to all or select locations equipped with speakers. A minimum of 25 separate distinct alarm signals shall be provided. Alarm signals originating from any assigned administrative telephone shall have priority over all regular system functions.
4. Programmable soft key access from any console to automatically broadcast page emergency instructions throughout an entire school when an alarm (e.g. lockdown, lockout, security, fire) is tripped or manually activated. The emergency instructions are preprogrammed and require no user intervention. The system provides redundant alarm annunciation over intercom/paging speakers and is not meant to replace primary fire alarm or security systems.
5. Ability to perform intercom to any single IP Addressable Speaker Module.
6. Ability to display 3 call-ins at a time on the screen, with unlimited number of call-ins annunciating and the ability to scroll to view all call-ins.
7. Ability to upgrade a call-in via soft key
8. Ability to change which bell event schedule(s) are active on current day.
9. Programmable soft key access from any console for activating relays, school wide
   Ability to maintain, along with controller and other IP Modules system functions, including intercom, bells and paging in the event of district wide connection loss.

E. Audio Paging/Program Amplifiers Biamp MCA 8050

1. Power amplifier(s) shall be provided to provide a minimum of 2 watts of power to all paging speakers, and 7 watts of power to all paging horns.
2. The maximum load on the paging/program amplifiers shall be 80% of the rated maximum output of the amplifiers.

F. Normal/Emergency Call Switch – Rauland TCC2211PB Dual Level Call In Switch Cancel

1. Normal/Emergency Call Switches indicated on the drawings shall provide the following functions and features:
   a. One (1) “Normal” call switch that shall activate a distinctive “NORM” level call from a single button activation. The button shall be clearly marked “NORM” and will route the call-in to any one or more Administrative Telephones or SIP interface to offsite telephones. This button may also be used as a “check-in” button during crisis situations.
   b. One (1) “Emergency” call switch that shall activate a distinctive “EMERGENCY” level call from a single button activation. The button shall be red in color and shall

be clearly marked “EMERGENCY” and will route the call-in to any one or more Administrative Telephones or SIP interface for quick and easy response from an Administrative Telephone or off-site telephone.

G. SIP Gateway

1. A SIP Gateway may be needed to differentiate existing classrooms from new classrooms equipped with IP speaker modules.
   a. The SIP Gateway shall provide a communications path to the existing intercom system.
   b. The Sip Gateway shall provide features and functions equivalent the Patton SmartNode ™ 4520 FXO series.

H. Uninterruptible Power Supplies (UPS)

1. UPS equipment provided for this system will include Power Conditioning to smooth current and voltage fluctuations.
2. UPS equipment will be sized in accordance with the system manufacturer’s recommendations.
3. Provide an individual UPS for EACH SYSTEM CONTROLLER (Gateway) furnished with the system.
4. Provide additional UPS(s) for protection of all other equipment furnished with the system and housed in the equipment racks.
5. All UPS equipment shall be rack mounted.

I. Equipment Racks

1. All equipment racks shall provide 44 spaces (77”) minimum for mounted system equipment.
2. All equipment racks shall be multi-rack format (“gangable”) style, bolted together, and open cavity.
3. All equipment racks will be provided with lockable rear doors.
4. Equipment rack(s) shall be located in climate-controlled areas/rooms as shown on drawings.
5. All head-end, distribution, and source equipment, including data and power, shall be located in racks configured as approved by the Engineer.
6. Rack mounted equipment shall be accessible from front and rear.
7. All unused rack spaces will be covered with appropriate blank/vent panels.

J. Analog Secondary Clocks

1. Analog clocks shall be designed to provide long term maintenance free timekeeping in any commercial application with a five (5) year manufacturer’s warranty.
2. Analog shall correct for time, hour, minute and second hands.
3. Typical recovery time after power failure shall be less than 2 minutes.
4. 12 inch analog clocks shall be supplied in all classrooms, administrative areas and common areas as indicated on the plans. 16 inch analog clocks shall be provided in auditoriums, and gymnasium with protective cover.

K. Wireless Clock System

1. Provide complete and satisfactorily operating NTP Synchronized Wireless Clock System with analog clocks as described herein, using materials and equipment of types, sizes, ratings, and performances as indicated.
2. (NTP) Network Time Protocol is a network standard protocol that assures accurate synchronization to the millisecond of computer clock times in a network of computers. Based on UTC, NTP synchronizes client workstation clocks to the U.S. Naval Observatory Master Clocks in Washington, DC and Colorado Springs, CO. running as a continuous background client program on a computer, NTP sends periodic time requests to servers, obtaining server time stamps and using them to adjust computer clocks.
3. The system shall be easy to learn and operate. All standard system programming shall be user friendly to allow the system administrator the ability to easily program system features.
4. Use materials and equipment that comply with referenced standards and manufacturers' standard design and construction, in accordance with published product information.
5. Coordinate the features of all materials and equipment so they form an integrated system, with components and interconnections matched for optimum performance of specified functions.
6. The NTP Synchronized Wireless System consists of a master transmitter located on the inside of the building, and a NTP receiver connected to a time server. An unlimited number of wireless analog and digital clocks are synchronized to the NTP time. System shall synchronize all clocks to each other. System shall utilize NTP technology to provide atomic time to components.
7. System shall not require hard wiring for its components except for 120 volt AC Power as noted.
8. Analog Clocks shall synchronize to +/- 1 second of the transmitter displayed time.
9. Clocks shall automatically adjust for Daylight Saving per settings on the transmitter
10. The system shall have an internal clock that is continually updated by the NTP receiver. If a NTP failure were to occur, the clocks would continue to be synchronized to the internal clock and would not deviate from each other. Once NTP time is restored, all clocks would once again be synchronized to the NTP time.
11. The system must have a fail safe design so that if a power interruption were to occur, the clocks will continue to operate. If a synch signal is not received by the analog clocks for 48 hours, the second hand will double pulse to indicate this condition. Upon restoration of power, the transmitter will once again communicate with the clocks and normal operation will resume.
12. System shall be 100% programmable from the front operational panel with lights that indicate power status and NTP reception. Panel programming will also include Time Zone, Frequency, 12 or 24 hour operation and DST on/off.
13. The wireless backbone must support expansion of the system to include wireless alphanumeric displays for emergency crisis communications for district-wide communications.
14. The system may be modified to use GPS instead of NTP as the time source without the need to replace the transmitter. A GPS receiver would need to be added with access to the outside of the building.
15. The system shall lend itself to expansion by simple addition of wireless secondary clocks and their required power source.
16. Equipment and Materials:

a. Wireless Transmitter:

1) FCC Part 90 Approved, 467.2125-467.4375 MHz frequency range.
2) Radio Technology (Narrowband FM, 12.5 KHz bandwidth).
3) 10 selectively available channels.
4) 5 watt transmitter.
5) Daylight Savings Time pre-programmed.
6) Time Zone Pre-set.
7) Non-Volatile Memory.
8) LCD Display for time, date, year, power, time zone and signal reception.
9) Operating Range (32 degrees F to 158 degrees F).
10) Rack or Shelf Mount.
11) Power Supply Input: 120-volt AC, Output: 12-volt DC, 3 Amps.
12) 7” Rear Mounted Antenna.
13) Dimensions: 12”L x 6”W x 1.75”H Weight: 2 lbs.
14) NTP Receiver.
15) Refer to drawings for wireless transmitter requirements.

b. Secondary 13” Analog Clocks:

1) 13” Wireless Analog Clock.
2) Battery-powered.
3) Maintenance Free.
4) Five year manufacturer’s warranty.
5) Microprocessor based with built-in wireless receiver.
6) Heavy Duty Construction.
7) Durable ABS Casing.
8) Clock numbering graphics shall be Standard Arabic Format (12HR-60 Minute).
9) Face of clock is white.
10) Hour and Minute hands shall be black, second hand is red.
11) The clock lens shall use a shatterproof polycarbonate material with no visible molding marks. Glass and/or visible molding marks are unacceptable.
12) The clock shall have a low–profile, semi–flush design.
13) Wire Guard Model in areas where protection is required as indicated on drawings or by owner.
14) Refer to electrical drawings for clock specifications.

c. Secondary 16” Analog Clocks:

1) 16” Analog Clock.
2) Battery-powered.
3) Maintenance Free.
4) Five year manufacturer’s warranty.
5) Microprocessor based with built-in wireless receiver
6) Heavy Duty Construction
7) Durable ABS Casing
8) Clock numbering graphics shall be Standard Arabic Format (12HR-60 Minute)
9) Face of clock is white
10) Hour and Minute hands shall be black, second hand is red
11) The clock lens shall use a shatterproof polycarbonate material with no visible molding marks. Glass and/or visible molding marks are unacceptable.
12) Wire Guard in areas where protection is required as indicated on drawings or by owner.
13) The clock shall have a low–profile, semi–flush design
14) Refer to electrical drawings for clock specifications.

L. Speakers:

1. Classroom Two-Way Speakers: Rauland BAFKIT1X2CS.
2. Ceiling Zone Speaker: Rauland BAFKIT1X2S.
3. Wall Zone Speaker: Atlas SD72 with Lowell P875X-4 back box and Lowell JG-8X grill.
4. Outside and Gym Horn: Rauland ACC1411.

2.3 IDENTIFICATION PRODUCTS

A. Comply with TIA/EIA-606-A and UL 969 for labeling materials, including label stocks, laminating adhesives, and inks used by label printers.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine conditions, with the Installer present, for compliance with requirements and other conditions affecting the performance of the School Communications and School Safety Network.

B. Do not proceed until unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. General: Install system in accordance with NFPA 70 and other applicable codes. Install equipment in accordance with manufacturer's written instructions.

B. Furnish and install all material, devices, components and equipment for a complete operational system.

C. Impedance and Level Matching: Carefully match input and output impedance's and signal levels at signal interfaces. Provide matching networks where required.

D. Control Circuit Wiring: Install control circuits in accordance with NFPA 70 and as indicated. Provide number of conductors as recommended by system manufacturer to provide control functions indicated or specified.

E. All housings are to be located as indicated.

F. The contractor shall provide necessary transient protection on the AC power feed, all copper station lines leaving or entering the building, and all central office trunks. All protection shall be as recommended by the equipment supplier and referenced to earth ground.

G. Wiring within Enclosures: Provide adequate length of conductors. Bundle, lace, and train the conductors to terminal points with no excess. Provide and use lacing bars.

H. Provide physical isolation from speaker-microphone, telephone, line-level wiring, and power wiring. Run in separate raceways, or where exposed or in same enclosure, provide 12 inch minimum separation between conductors to speaker-microphones, telephone wiring and adjacent parallel power. Provide physical separation as recommended by equipment manufacturer for other system conductors.

I. Identification of Conductors and Cables: Use color coding of conductors and apply wire and cable marking tape to designate wires and cables so all media are identified in coordination with system wiring diagrams.

J. Weatherproofing: Provide weatherproof enclosures for items to be mounted outdoors or exposed to weather.

3.3 GROUNDING

A. Provide equipment grounding connections for Integrated Electronic Communications Network systems as indicated. Tighten connections to comply with tightening torques specified in UL Standard 486A to assure permanent and effective grounds.

B. Ground equipment, conductor, and cable shields to eliminate shock hazard and to minimize to the greatest extent possible, ground loops, common mode returns, noise pickup, cross talk, and other impairments. Provide 5-ohm ground at main equipment location. Measure, record, and report ground resistance.

C. Provide all necessary transient protection on the AC power feed and on all copper station lines leaving or entering the building. Note in system drawings, the type and location of these protection devices as well as all wiring information.

3.4 WIRING METHODS

A. Install cables in raceways and cable trays except within consoles, cabinets, desks, counters, and accessible lay-in tile ceilings. Install cabling with horizontal and vertical cable guides in telecommunications spaces with terminating hardware and interconnection equipment. Where cables are routed in accessible lay-in tile suspended ceilings, secure and support cables with J-hooks a minimum of 8 inches (200 mm) above ceilings and not more than 60 inches (1524 mm) apart; cable shall not be run through structural members or in contact with pipes, ducts, or other potentially damaging items. Install cables in open ceilings (finished and unfinished) in raceways. Where raceways are installed in finished ceilings, paint raceways to match the color of the surrounding surface.

1. Install plenum cable in environmental air spaces, including plenum ceilings.
2. Comply with requirements in Section 260110 "Conduit Raceways." Minimum raceway size is 3/4".
3. Comply with requirements in Section 260111 "Cable Trays."

B. Wiring within Enclosures:

1. Bundle, lace, and train conductors to terminal points with no excess and without exceeding manufacturer's limitations on bending radii.
2. Install lacing bars and distribution spools.
3. Install conductors parallel with or at right angles to sides and back of enclosure.

3.5 INSTALLATION OF CABLES

A. Comply with NECA 1.

B. General Requirements for Cabling:

1. Comply with TIA/EIA-568-B.1.
2. Comply with BICSI ITSIM, Ch. 6, and "Cable Termination Practices."
3. Terminate conductors in accordance with all manufacturer's recommendations.
4. Cables may not be spliced. Secure and support cables at intervals not exceeding 30 inches (760 mm) and not more than 6 inches (150 mm) from cabinets, boxes, fittings, outlets, racks, frames, and terminals.
5. Install lacing bars to restrain cables, to prevent straining connections, and to prevent bending cables to smaller radii than minimums recommended by manufacturer.
6. Bundle, lace, and train conductors to terminal points without exceeding manufacturer's limitations on bending radii, but not less than radii specified in BICSI ITSIM, "Cabling Termination Practices" Chapter. Install lacing bars and distribution spools.
7. Do not install bruised, kinked, scored, deformed, or abraded cable. Do not splice cable between termination, tap, or junction points. Remove and discard cable if damaged during installation and replace it with new cable.
8. Cold-Weather Installation: Bring cable to room temperature before dereeling. Heat lamps shall not be used for heating.
9. In the communications equipment room, install a 10-foot- (3-m-) long service loop on each end of cable.
10. Pulling Cable: Comply with BICSI ITSIM, Ch. 4, and "Pulling Cable." Monitor cable pull tensions.

C. UTP Cable Installation:

1. Comply with TIA/EIA-568-B.2.
2. Do not untwist UTP cables more than 1/2 inch (12 mm) from the point of termination to maintain cable geometry.

D. Group connecting hardware for cables into separate logical fields.

E. Separation from EMI Sources:

1. Comply with BICSI TDMM and TIA-569-B for separating unshielded copper voice and data communication cable from potential EMI sources, including electrical power lines and equipment.
2. Separation between open communications cables or cables in nonmetallic raceways and unshielded power conductors and electrical equipment shall be as follows:
   a. Electrical Equipment Rating Less Than 2 kVA: A minimum of 5 inches (127 mm).
   b. Electrical Equipment Rating between 2 and 5 kVA: A minimum of 12 inches (300 mm).
   c. Electrical Equipment Rating More Than 5 kVA: A minimum of 24 inches (610 mm).
3. Separation between communications cables in grounded metallic raceways and unshielded power lines or electrical equipment shall be as follows:
   a. Electrical Equipment Rating Less Than 2 kVA: A minimum of 2-1/2 inches (64 mm).
   b. Electrical Equipment Rating between 2 and 5 kVA: A minimum of 6 inches (150 mm).
   c. Electrical Equipment Rating More Than 5 kVA: A minimum of 12 inches (300 mm).
4. Separation between communications cables in grounded metallic raceways and power lines and electrical equipment located in grounded metallic conduits or enclosures shall be as follows:
   a. Electrical Equipment Rating Less Than 2 kVA: No requirement.
   b. Electrical Equipment Rating between 2 and 5 kVA: A minimum of 3 inches (76 mm).
   c. Electrical Equipment Rating More Than 5 kVA: A minimum of 6 inches (150 mm).
5. Separation between Communications Cables and Electrical Motors and Transformers, 5 kVA or HP and Larger: A minimum of 48 inches (1200 mm).
6. Separation between Communications Cables and Fluorescent Fixtures: A minimum of 5 inches (127 mm).

3.6 FIRESTOPPING

A. Comply with requirements in Section 078413 "Penetration Firestopping."

B. Comply with TIA-569-B, Annex A, "Firestopping."

C. Comply with BICSI TDMM, "Firestopping Systems" Article.

3.7 IDENTIFICATION

A. Identify system components, wiring, and cabling complying with TIA/EIA-606-A. Comply with requirements for identification specified in Section 260553 "Identification for Electrical Systems."

1. Administration Class: 2.

2. Color-code cross-connect fields. Apply colors to voice and data service backboards, connections, covers, and labels. See Evaluations for discussion about TIA/EIA standard as it applies to this Section.

B. Paint and label colors for equipment identification shall comply with TIA/EIA-606-A for Class 2 level of administration, including optional identification requirements of this standard.

C. Cable Schedule: Post in prominent location in each equipment room and wiring closet. List incoming and outgoing cables and their designations, origins, and destinations. Protect with rigid frame and clear plastic cover. Furnish an electronic copy of final comprehensive schedules for Project.

D. Cabling Administration Drawings: Show building floor plans with cabling administration-point labeling. Identify labeling convention and show labels for telecommunications closets, backbone pathways and cables, entrance pathways and cables, terminal hardware and positions, horizontal cables, work areas and workstation terminal positions, grounding buses and pathways, and equipment grounding conductors. Follow convention of TIA/EIA-606-A. Furnish electronic record of all drawings, in software and format selected by Owner. Provide three (3) hard copies to owner. Provide one (1) drawing in each equipment room and wiring closet and post in a prominent location. Protect with rigid frame and clear plastic cover.

E. Cable and Wire Identification:

1. Label each cable within 4 inches (100 mm) of each termination and tap, where it is accessible in a cabinet or junction or outlet box, and elsewhere as indicated.

2. Label each terminal strip and screw terminal in each cabinet, rack, or panel.
   a. Individually number wiring conductors connected to terminal strips, and identify each cable or wiring group being extended from a panel or cabinet to a building-mounted device shall be identified with name and number of particular device as shown.
   b. Label each unit and field within distribution racks and frames.

3. Identification within Connector Fields in Equipment Rooms and Wiring Closets: Label each connector and each discrete unit of cable-terminating and connecting hardware. Where similar jacks and plugs are used for both voice and data communication cabling, use a different color for jacks and plugs of each service.

4. Meet with the Owner's Telecommunications personnel and coordinate labeling requirements prior to installation.

F. Labels shall be preprinted or computer-printed type with printing area and font color that contrasts with cable jacket color but still complies with requirements in TIA/EIA-606-A.

1. Cables use flexible vinyl or polyester that flex as cables are bent.

3.8 FIELD QUALITY CONTROL

A. Manufacturer's Field Services: Provide services of a duly factory authorized service representative for this project location to supervise the field assembly and connection of components and the pre-testing, testing, and adjustment of the system.

B. Inspection: Make observations to verify that units and controls are properly labeled, and interconnecting wires and terminals are identified. Provide a list of final tap settings of paging speaker line matching transformers.

C. Testing: Rectify deficiencies indicated by tests and completely re-test work affected by such deficiencies at Contractor's expense. Verify by the system test that the total system meets the Specifications and complies with applicable standards.

3.9 FINAL ACCEPTANCE TESTING

A. The Final Acceptance Testing shall be provided to the Owner or the Owners designated representative only. Final acceptance testing to any other trade or service provider for the project will not comply with the requirements of this section.

B. The contractor will provide a Final Acceptance Test record document signed by both the contractor and the Owner or designated Owner's Representative establishing the "In Warranty" date. The warranty period will not commence until the Final Acceptance Test is completed.

C. Be prepared to verify the performance of any portion of the installation by demonstration, listening and viewing test, and instrumented measurements. Make additional adjustments within the scope of work and which are deemed necessary by the Owner because of the acceptance test.

3.10 COMMISSIONING

A. The contractor shall train the Owner's maintenance personnel in the procedures and schedules involved in operating, troubleshooting, servicing, and preventative maintenance of the system. This training will be in accordance with the training as outlined in Section 1.6, paragraphs 3, 5 & 6 of these specifications. In addition to the Training Materials provided, the contractor will also furnish Operators Manuals and Users Guides at the time of this training.

B. Schedule training with Owner through the owner's representative, with at least seven days advance notice.

3.11 OCCUPANCY ADJUSTMENTS

A. The contractor shall provide Occupancy Adjustments in accordance with Section 1.6, paragraph 9 of these specifications. A response scenario amenable to both the owner and the contractor will be established and followed for the first year of service.

3.12 CLEANING AND PROTECTION

A. Prior to final acceptance, the contractor shall vacuum and clean all system components and protect them from damage and deterioration. All blank spaces in equipment cabinets will be covered with blank panels. Top and side panels, and all cabinet doors will be installed. All general areas within and around all equipment rack/cabinets in the facility will be swept, vacuumed, and cleaned up. No cabinets will be left unlocked and all cabinet keys will be turned over to the owner or designated owner's representative.

END OF SECTION 27 51 23

SECTION 28 07 21 – DIGITAL, ADDRESSABLE FIRE-ALARM SYSTEM

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. Fire-alarm control unit.
2. Manual fire-alarm boxes.
3. System smoke detectors.
4. Heat detectors.
5. Notification appliances.
6. Remote annunciator.
7. Addressable interface device.
8. Digital alarm communicator transmitter.

1.3 DEFINITIONS

A. LED: Light-emitting diode.

B. NICET: National Institute for Certification in Engineering Technologies.

1.4 SYSTEM DESCRIPTION

A. Noncoded, addressable system, with multiplexed signal transmission, dedicated to fire-alarm service only.

B. System shall be UL-listed and factory mutual-approved.

1.5 PERFORMANCE REQUIREMENTS

A. Seismic Performance: Fire-alarm control unit and raceways shall withstand the effects of earthquake motions determined according to SEI/ASCE 7.

1. The term "withstand" means "the unit will remain in place without separation of any parts from the device when subjected to the seismic forces specified and the unit will be fully operational after the seismic event."

1.6 SUBMITTALS

A. General Submittal Requirements:

1. Submittals shall be approved by authorities having jurisdiction prior to submitting them to Architect.
2. Shop Drawings shall be prepared by persons with the following qualifications:
   a. Trained and certified by manufacturer in fire-alarm system design.

b. NICET-certified fire-alarm technician, Level III minimum.
c. Licensed or certified by authorities having jurisdiction.

B. Product Data: For each type of product indicated.

C. Shop Drawings: For fire-alarm system. Include plans, elevations, sections, details, and attachments to other work.

1. Comply with recommendations in the "Documentation" Section of the "Fundamentals of Fire Alarm Systems" Chapter in NFPA 72.
2. Include voltage drop calculations for notification appliance circuits.
3. Include battery-size calculations.
4. Include performance parameters and installation details for each detector, verifying that each detector is listed for complete range of air velocity, temperature, and humidity possible when air-handling system is operating.
5. Include plans, sections, and elevations of heating, ventilating, and air-conditioning ducts, drawn to scale and coordinating installation of duct smoke detectors and access to them. Show critical dimensions that relate to placement and support of sampling tubes, detector housing, and remote status and alarm indicators. Locate detectors according to manufacturer's written recommendations.
6. Include voice/alarm signaling-service equipment rack or console layout, grounding schematic, amplifier power calculation, and single-line connection diagram.
7. Include floor plans to indicate final outlet locations showing address of each addressable device. Show size and route of cable and conduits.

D. Qualification Data: For qualified Installer.

E. Seismic Qualification Certificates: For fire-alarm control unit, accessories, and components, from manufacturer.

1. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.
2. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.
3. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.

F. Field quality-control reports.

G. Operation and Maintenance Data: For fire-alarm systems and components to include in emergency, operation, and maintenance manuals. In addition to items specified in Section 017823 – Operation and Maintenance Data, include the following:

1. Comply with the "Records" Section of the "Inspection, Testing and Maintenance" Chapter in NFPA 72.
2. Provide "Record of Completion Documents" according to NFPA 72 article "Permanent Records" in the "Records" Section of the "Inspection, Testing and Maintenance" Chapter.
3. Record copy of site-specific software.
4. Provide "Maintenance, Inspection and Testing Records" according to NFPA 72 article of the same name and include the following:
   a. Frequency of testing of installed components.
   b. Frequency of inspection of installed components.
   c. Requirements and recommendations related to results of maintenance.
   d. Manufacturer's user training manuals.
5. Manufacturer's required maintenance related to system warranty requirements.

6. Abbreviated operating instructions for mounting at fire-alarm control unit.
7. Copy of NFPA 25.

H. Software and Firmware Operational Documentation:

1. Software operating and upgrade manuals.
2. Program Software Backup: On magnetic media or compact disk, complete with data files.
3. Device address list.
4. Printout of software application and graphic screens.

I. The disks containing fire alarm files shall be supplied to the owner. These disks shall include all information required to allow the owner to change the fire alarm program themselves. These computer disks shall contain a minimum of the following:

1. CAD drawing files of the building fire alarm map.
2. CAD drawing files of as-build fire alarm component and point-to-point connections.
3. General configuration programming.
4. Job-specific configuration programming.
5. Tutorial file on complete programming of the fire alarm system.

J. The system contractor/supplier shall provide a “Certificate of Compliance” to the Authority Having Jurisdiction in accordance with NFPA Pamphlet 72B (1986 Edition), Section 2-2.6, at the completion of operational acceptance tests, as required herein. This will be applicable to all types of fire alarm systems.

K. A complete set of CAD “as-built” drawings showing installed wiring, color coding, specific interconnections between all equipment, and internal wiring of equipment shall be delivered to the owner upon completion of the system installation.

1.7 QUALITY ASSURANCE

A. Installer Qualifications: Personnel shall be trained and certified by manufacturer for installation of units required for this Project. Installation shall be by personnel certified by NICET as fire-alarm Level III or Level IV technician

B. Source Limitations for Fire-Alarm System and Components: Obtain fire-alarm system from single source from single manufacturer. Components shall be compatible with, and operate as, an extension of existing system.

C. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

1.8 SOFTWARE SERVICE AGREEMENT

A. Comply with UL 864.

B. Technical Support: Beginning with Substantial Completion, provide software support for two years.

C. Upgrade Service: Update software to latest version at Project completion. Install and program software upgrades that become available within two years from date of Substantial Completion. Upgrading software shall include operating system. Upgrade shall include new or revised licenses for use of software.

1. Provide 30 days' notice to Owner to allow scheduling and access to system and to allow Owner to upgrade computer equipment if necessary.

1.9 EXTRA MATERIALS

A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Lamps for Remote Indicating Lamp Units: Quantity equal to 10 percent of amount installed, but no fewer than 1 unit.
2. Lamps for Strobe Units: Quantity equal to 10 percent of amount installed, but no fewer than 1 unit.
3. Smoke Detectors, Fire Detectors**[, and Flame Detectors]**: Quantity equal to 10 percent of amount of each type installed, but no fewer than 1 unit of each type.
4. Detector Bases: Quantity equal to 2 percent of amount of each type installed, but no fewer than 1 unit of each type.
5. Keys and Tools: One extra set for access to locked and tamperproofed components.
6. Audible and Visual Notification Appliances: One of each type installed.
7. Fuses: Two of each type installed in the system.

PART 2 – PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers / Installers: Subject to compliance with requirements, provide products by one of the following:

Manufacturer	Installer / Telephone
Edwards Systems Technology	Convergint Technologies / (801) 977-8705 Summit Fire / (801) 649-6696 Wasatch Electric / (801) 487-4511 State Fire Sales and Service / (801) 288-2100
Gamewell / Fire Control Instruments	Certified Fire & Security / (801) 281-0746 Nelson Fire Systems / (801) 468-8300
Notifier	Fire Protection Services Corp. / (801) 363-9696 AAA Fire Safety & Alarm, Inc / (801) 544-7345
Potter	Certified Fire & Security / (801) 281-0746 Convergint Technologies / (801) 977-8705 Summit Fire / (801) 576-6634 State Fire Sales and Service / (801) 288-2100 IFS / (385) 425-2600 AAA Fire Safety & Alarm, Inc / (801) 544-7345

2.2 SYSTEMS OPERATIONAL DESCRIPTION

A. Fire-alarm signal initiation shall be by one or more of the following devices and systems:

1. Manual stations.
2. Heat detectors.
3. Flame detectors.
4. Smoke detectors.
5. Duct smoke detectors.
6. Verified automatic alarm operation of smoke detectors.
7. Automatic sprinkler system water flow.
8. Heat detectors in elevator shaft and pit.

B. Fire-alarm signal shall initiate the following actions:

1. Continuously operate alarm notification appliances.
2. Identify alarm at fire-alarm control unit and remote annunciators.
3. Transmit an alarm signal to the 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. Switch heating, ventilating, and air-conditioning equipment controls to fire-alarm mode.
7. Close smoke dampers in air ducts of designated air-conditioning duct systems.
8. Recall elevators to primary or alternate recall floors.
9. Activate emergency shutoffs for gas and fuel supplies.
10. Record events in the system memory.

C. Supervisory signal initiation shall be by one or more of the following devices and actions:

1. Valve supervisory switch.
2. Low-air-pressure switch of a dry-pipe sprinkler system.
3. Elevator shunt-trip supervision.

D. System trouble signal initiation shall 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 primary power at fire-alarm control unit.
4. Ground or a single break in fire-alarm control unit internal circuits.
5. Abnormal ac voltage at fire-alarm control unit.
6. Break in standby battery circuitry.
7. Failure of battery charging.
8. Abnormal position of any switch at fire-alarm control unit or annunciator.

E. System Trouble and Supervisory Signal Actions: Initiate notification appliance and annunciate at fire-alarm control unit and remote annunciators. Record the event on system printer.

2.3 FIRE-ALARM CONTROL UNIT

A. General Requirements for Fire-Alarm Control Unit:

1. Field-programmable, microprocessor-based, modular, power-limited design with electronic modules, complying with UL 864 and listed and labeled by an NRTL.
   a. System software and programs shall be held in flash electrically erasable programmable read-only memory (EEPROM), retaining the information through failure of primary and secondary power supplies.
   b. Include a real-time clock for time annotation of events on the event recorder and printer.
2. Addressable initiation devices that communicate device identity and status.

a. Smoke sensors shall additionally communicate sensitivity setting**[and allow for adjustment of sensitivity at fire-alarm control unit]**.
b. Temperature sensors shall additionally test for and communicate the sensitivity range of the device.

3. Addressable control circuits for operation of mechanical equipment.

B. Alphanumeric Display and System Controls: Arranged for interface between human operator at fire-alarm control unit and addressable system components including annunciation and supervision. Display alarm, supervisory, and component status messages and the programming and control menu.

1. Annunciator and Display: Liquid-crystal type, two (2) lines of forty (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 the system for control of smoke-detector sensitivity and other parameters]**.

C. Circuits:

1. Initiating Device, Notification Appliance, and Signaling Line Circuits: NFPA 72, Class A.
   a. Initiating Device Circuits: Style D.
   b. Notification Appliance Circuits: Style Z.
   c. Signaling Line Circuits: Style 6.
   d. Install no more than 100 addressable devices on each signaling line circuit.

D. Notification Appliance Circuit: Operation shall sound in Temporal Pattern 3.

E. Elevator Recall:

1. Smoke detectors at the following locations shall initiate automatic elevator recall. Alarm-initiating devices, except those listed, shall not start elevator recall.
   a. Elevator lobby detectors except the lobby detector on the designated floor.
   b. Smoke detector in elevator machine room.
   c. Smoke detectors in elevator hoistway.
2. Elevator lobby detectors located on the designated recall floors shall be programmed to move the cars to the alternate recall floor.
3. Water-flow alarm connected to sprinkler in an elevator shaft and elevator machine room shall shut down elevators associated with the location without time delay.
   a. Water-flow switch associated with the sprinkler in the elevator pit may have a delay to allow elevators to move to the designated floor.

F. Door Controls: Door hold-open devices that are controlled by smoke detectors at doors in smoke barrier walls shall be connected to fire-alarm system.

G. Remote Smoke-Detector Sensitivity Adjustment: Controls shall select specific addressable smoke detectors for adjustment, display their current status and sensitivity settings, and change those settings. Allow controls to be used to program repetitive, time-scheduled, and automated changes in sensitivity of specific detector groups. Record sensitivity adjustments and sensitivity-adjustment schedule changes in system memory, and print out the final adjusted values on system printer.

H. Transmission to Remote Alarm Receiving Station: Automatically transmit alarm, supervisory, and trouble signals to a remote alarm station.

I. Primary Power: 24-V dc obtained from 120-V ac service and a power-supply module. Initiating

devices, notification appliances, signaling lines, trouble signals, supervisory and digital alarm communicator transmitters shall be powered by 24-V dc source.

1. Alarm current draw of entire fire-alarm system shall not exceed 80 percent of the power-supply module rating.

J. Secondary Power: 24-V dc supply system with batteries, automatic battery charger, and automatic transfer switch.

1. Batteries: Sealed, valve-regulated, recombinant lead acid.
2. Capacity: Size for all finished and unfinished spaces within building plus twenty-five (25) percent ampere-hour capacity.

K. Instructions: Computer printout or typewritten instruction card mounted behind a plastic or glass cover in a stainless-steel or aluminum frame. Include interpretation and describe appropriate response for displays and signals. Briefly describe the functional operation of the system under normal, alarm, and trouble conditions.

2.4 MANUAL FIRE-ALARM BOXES

A. General Requirements for Manual Fire-Alarm Boxes: Comply with UL 38. Boxes shall be finished in red with molded, raised-letter operating instructions in contrasting color; shall show visible indication of operation; and shall 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 an alarm, pull-lever type; with integral addressable module arranged to communicate manual-station status (normal, alarm, or trouble) to fire-alarm control unit.
2. Station Reset: Key-operated switch.
3. Indoor Protective Shield: Factory-fabricated clear plastic enclosure hinged at the top to permit lifting for access to initiate an alarm. Lifting the cover actuates an integral battery-powered audible horn intended to discourage false-alarm operation.
4. Weatherproof Protective Shield: Factory-fabricated clear plastic enclosure hinged at the top to permit lifting for access to initiate an alarm.

2.5 SYSTEM SMOKE DETECTORS

A. General Requirements for System Smoke Detectors:

1. Detectors shall be two-wire type.
2. Detectors shall have an Integral Addressable Module, arranged to communicate detector status (normal, alarm, or trouble) to fire-alarm control unit. Detectors shall also be base-mounted, with the detector and associated electronic components mounted in a twist-lock module that connects to a fixed base. Provide terminals in the 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. Remote Control: Unless otherwise indicated, detectors shall be analog-addressable type, individually monitored at fire-alarm control unit for calibration, sensitivity, and alarm condition and individually adjustable for sensitivity by fire-alarm control unit.
   a. Rate-of-rise temperature characteristic shall be selectable at fire-alarm control unit for 15 or 20 deg F (8 or 11 deg C) per minute.
   b. Fixed-temperature sensing shall be independent of rate-of-rise sensing and shall

be settable at fire-alarm control unit to operate at 135 or 155 deg F (57 or 68 deg C).

c. Provide multiple levels of detection sensitivity for each sensor.

B. Photoelectric Smoke Detectors:

1. Detector address shall be accessible from fire-alarm control unit and shall be able to identify the detector's location within the system and its sensitivity setting.
2. An operator at fire-alarm control unit, having the designated access level, shall 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.).
3. This is the default detector type to be used on the product, unless specifically indicated otherwise.

C. Duct Smoke Detectors: Photoelectric type complying with UL 268A.

1. Detector address shall be accessible from fire-alarm control unit and shall be able to identify the detector's location within the system and its sensitivity setting.
2. An operator at fire-alarm control unit, having the designated access level, shall 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.).
3. Weatherproof Duct Housing Enclosure: NEMA 250, Type 4X; NRTL listed for use with the supplied detector.
4. Each sensor shall have multiple levels of detection sensitivity.
5. Sampling Tubes: Design and dimensions as recommended by manufacturer for specific duct size, air velocity, and installation conditions where applied.
6. Relay Fan Shutdown: Rated to interrupt fan motor-control circuit.

2.6 HEAT DETECTORS

A. General Requirements for Heat Detectors: Comply with UL 521.

B. Heat Detector, Combination Type: Actuated by either a fixed temperature of 135 deg F (57 deg C) or a rate of rise that exceeds 15 deg F (8 deg C) per minute unless otherwise indicated.

1. Mounting: Twist-lock base interchangeable with smoke-detector bases.
2. Integral Addressable Module: Arranged to communicate detector status (normal, alarm, or trouble) to fire-alarm control unit.

C. Heat Detector, Fixed-Temperature Type: Actuated by temperature that exceeds a fixed temperature of 190 deg F (88 deg C).

1. Mounting: Twist-lock base interchangeable with smoke-detector bases.
2. Integral Addressable Module: Arranged to communicate detector status (normal, alarm, or trouble) to fire-alarm control unit.

2.7 NOTIFICATION APPLIANCES

A. General Requirements for Notification Appliances: Connected to notification appliance signal circuits, zoned as indicated, equipped for mounting as indicated and with screw terminals for system connections.

1. Combination Devices: Factory-integrated audible and visible devices in a single-mounting assembly, equipped for mounting as indicated and with screw terminals for system connections.

B. Horns: Electric-vibrating-polarized type, 24-V dc; with provision for housing the operating mechanism behind a grille. Comply with UL 464. Horns shall produce a sound-pressure level of 90 dBA, measured 10 feet (3 m) from the horn, using the coded signal prescribed in UL 464 test protocol.

C. Visible Notification Appliances: Xenon strobe lights comply with UL 1971, with clear or nominal white polycarbonate lens mounted on an aluminum faceplate. The word "FIRE" is engraved in minimum 1-inch- (25-mm-) high letters on the lens.

1. Rated Light Output:
   a. 15/30/75/110 cd, as indicated in drawings, or
   b. 15/30/75/110 cd, selectable in the field.
2. Mounting: Wall mounted unless otherwise indicated.
3. For units with guards to prevent physical damage, light output ratings shall be determined with guards in place.
4. Flashing shall be in a temporal pattern, synchronized with other units.
5. Strobe Leads: Factory connected to screw terminals.
6. Mounting Faceplate: Factory finished, white.

2.8 MAGNETIC DOOR HOLDERS

A. Description: Provided with the door hardware. Confirm with Architect.

2.9 REMOTE ANNUNCIATOR

A. Description: Annunciator functions shall match those of fire-alarm control unit for alarm, supervisory, and trouble indications. Manual switching functions shall match those of fire-alarm control unit, 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 shall match those of fire-alarm control unit. Provide controls to acknowledge, silence, reset, and test functions for alarm, supervisory, and trouble signals.

2.10 ADDRESSABLE INTERFACE DEVICE

A. Description: Microelectronic monitor module, NRTL listed for use in providing a system address for alarm-initiating devices for wired applications with normally open contacts.

B. Integral Relay: Capable of providing a direct signal to elevator controller to initiate elevator recall and to circuit-breaker shunt trip for power shutdown.

2.11 DIGITAL ALARM COMMUNICATOR TRANSMITTER

A. Digital alarm communicator transmitter shall be acceptable to the remote central station and shall comply with UL 632 and be listed and labeled by an NRTL.

B. Functional Performance: Unit shall receive an alarm, supervisory, or trouble signal from fire-alarm control unit and automatically capture two telephone line(s) and dial a preset number for a remote central station. When contact is made with central station(s), signals shall be transmitted. If service on either line is interrupted for longer than 45 seconds, transmitter shall initiate a local trouble signal and transmit the signal indicating loss of telephone line to the remote alarm receiving station over the remaining line. Transmitter shall automatically report telephone service restoration to the central station. If service is lost on both telephone lines, transmitter shall initiate the local trouble signal.

C. Local functions and display at the digital alarm communicator transmitter shall include the following:

1. Verification that both telephone lines are available.
2. Programming device.
3. LED display.
4. Manual test report function and manual transmission clear indication.
5. Communications failure with the central station or fire-alarm control unit.

D. Digital data transmission shall include the following:

1. Address of the alarm-initiating device.
2. Zone of the supervisory signal.
3. Zone of the trouble-initiating device.
4. Loss of ac supply or loss of power.
5. Low battery.
6. Abnormal test signal.
7. Communication bus failure.

E. Self-Test: Conducted automatically every 24 hours with report transmitted to central station.

2.12 DEVICE GUARDS

A. Description: Welded wire mesh of size and shape for the manual station, smoke detector, gong, or other device requiring protection.

1. Factory fabricated and furnished by manufacturer of device.
2. Finish: Paint of color to match the protected device.

PART 3 – EXECUTION

3.1 EQUIPMENT INSTALLATION

A. Comply with NFPA 72 for installation of fire-alarm equipment.

B. Power for the panel, battery charger, or any other device which affects the operation of the system shall be controlled through a single circuit breaker labeled, “Fire Alarm System – Do Not Turn Off.” Connect to engine generator-supported emergency circuit where available.

C. Equipment Mounting: Install wall-mounted fire-alarm control unit on finished floor with tops of cabinets not more than 72 inches (1830 mm) above the finished floor.

1. Comply with requirements for seismic-restraint devices specified in Section 260072 – Electrical Supports and Seismic Restraints.

2. Locate fire alarm control unit as directed by the authority having jurisdiction.

D. Raceway: Install fire alarm conductors in raceway. Fire alarm system conductors from different zones may be combined in common conduit. Make certain that raceway and wire quantity, size, and type are suitable for equipment supplied and is within NEC standards. No wiring other than that directly associated with the fire alarm and detection systems shall be permitted inside the fire alarm conduits. All conduit, mounting boxes, junction boxes, panels, detectors, alarm devices, etc., shall be mounted and fastened with appropriate fittings to insure positive grounding throughout the system.

E. Loop wires through each device in zone for proper supervision. Tee-taps are not permitted. Wiring splices are to be avoided to the maximum extent possible; if needed, they must be made only in junction boxes. Transposing or changing color-coding of the wires shall not be permitted.

F. Provide dust protection for installed and existing (if any) smoke detectors until finish work is completed and building is ready for occupancy.

G. Protect conductors from cuts, abrasion, and other damage during construction.

H. Minimum conductor size shall be 14 AWG, unless otherwise specified. Shielded and/or stranded conductors shall be provided where recommended by the manufacturer.

I. Connecting to Existing Equipment: Verify that existing fire-alarm system is operational before making changes or connections.

1. Connect new equipment to existing control panel in existing part of the building.
2. Connect new equipment to existing monitoring equipment at the supervising station.
3. Expand, modify, and supplement existing control equipment as necessary to extend existing control functions to the new points. New components shall be capable of merging with existing configuration without degrading the performance of either system.

J. Smoke- or Heat-Detector Spacing:

1. Comply with NFPA 72, "Smoke-Sensing Fire Detectors" Section in the "Initiating Devices" Chapter, for smoke-detector spacing.
2. Comply with NFPA 72, "Heat-Sensing Fire Detectors" Section in the "Initiating Devices" Chapter, for heat-detector spacing.
3. Smooth ceiling spacing shall not exceed 30 feet (9 m).
4. Spacing of detectors for irregular areas, for irregular ceiling construction, and for high ceiling areas shall be determined according to Appendix A or Appendix B in NFPA 72.
5. HVAC: Locate detectors not closer than 3 feet (1 m) from air-supply diffuser or return-air opening.
6. Lighting Fixtures: Locate detectors not closer than 12 inches (300 mm) from any part of a lighting fixture.

K. Duct Smoke Detectors: Comply with NFPA 72 and NFPA 90A. Install sampling tubes so they extend the full width of duct.

L. Heat Detectors in Elevator Shafts: Coordinate temperature rating and location with sprinkler rating and location.

M. Remote Status and Alarm Indicators: Install near each smoke detector and each sprinkler water-flow switch and valve-tamper switch that is not readily visible from normal viewing position.

N. Audible Alarm-Indicating Devices: Install at +80 inches (2032 mm) above finished floor, but not less than 6 inches (150 mm) below the ceiling. Install bells and horns on flush-mounted back boxes with the device-operating mechanism concealed behind a grille.

O. Visible Alarm-Indicating Devices: Install adjacent to each alarm bell or alarm horn at +80 inches (2032 mm) above finished floor, but at least 6 inches (150 mm) below the ceiling.

P. Device Location-Indicating Lights: Locate in public space near the device they monitor.

Q. Fire-Alarm Control Unit: Surface mounted, with tops of cabinets not more than 72 inches (1830 mm) above the finished floor.

R. Annunciator: Install with top of panel not more than 72 inches (1830 mm) above the finished floor.

S. Do not install manual fire alarm boxes close to light switches.

T. Post copy of wire identification list inside fire alarm panel door and other area accessible to fire alarm service personnel.

U. The control and other panels shall be mounted with sufficient clearance for observation and testing.

V. All fire alarm junction boxes shall be identified with zone number and red paint for easy identification.

W. Mount remote multi-signialing accessory for non-system duct smoke detector in a readily accessible location and wire complete.

3.2 CONNECTIONS

A. Make addressable connections with a supervised interface device to the following devices and systems. Install the interface device less than 3 feet (1 m) from the device controlled. Make an addressable confirmation connection when such feedback is available at the device or system being controlled.

1. Smoke dampers in air ducts of designated air-conditioning duct systems.
2. Alarm-initiating connection to elevator recall system and components.
3. Alarm-initiating connection to activate emergency shutoffs for gas and fuel supplies.
4. Supervisory connections at valve supervisory switches.
5. Supervisory connections at elevator shunt trip breaker.

3.3 IDENTIFICATION

A. Identify system components, wiring, cabling, and terminals. Comply with requirements for identification specified in Section 260553 – Identification for Electrical Systems.

B. Install framed instructions in a location visible from fire-alarm control unit.

C. All fire detection devices shall be marked in nominal ½" high letters with the zone and device number (for example: a mark reading, "1-20," indicated Zone 1, Device Number 20).

D. Building Fire Map:

1. A building fire alarm map shall be supplied to the owner, indicating the exact location and

address of all individual devices. Install the building map adjacent to the fire alarm panel. Provide a high-quality plastic sign (map holder) with two layers. The back layer shall be painted black. The front layer shall have a clear center for viewing the CAD fire alarm drawing. The edges of the sign shall be colored to match the building interior. The building map shall indicate zoning by the use of five different colors, minimum.

3.4 GROUNDING

A. Ground fire-alarm control unit and associated circuits; comply with IEEE 1100. Install a ground wire from main service ground to fire-alarm control unit.

3.5 FIELD QUALITY CONTROL

A. Field tests shall be witnessed by Engineer and authorities having jurisdiction .

B. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect, test, and adjust components, assemblies, and equipment installations, including connections.

C. 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.

D. Tests and Inspections:

1. Visual Inspection: Conduct visual inspection prior to testing.
   a. Inspection shall be based on completed Record Drawings and system documentation that is required by NFPA 72 in its "Completion Documents, Preparation" Table in the "Documentation" Section of the "Fundamentals of Fire Alarm Systems" Chapter.
   b. Comply with "Visual Inspection Frequencies" Table in the "Inspection" Section of the "Inspection, Testing and Maintenance" Chapter in NFPA 72; retain the "Initial/Reacceptance" column and list only the installed components.
2. System Testing: Comply with "Test Methods" Table in the "Testing" Section of the "Inspection, Testing and Maintenance" Chapter in NFPA 72.
3. Test audible appliances for the public operating mode according to manufacturer's written instructions and Authority Having Jurisdiction. Perform the test using a portable sound-level meter complying with Type 2 requirements in ANSI S1.4.
4. Test audible appliances for the private operating mode according to manufacturer's written instructions and Authority Having Jurisdiction.
5. Test visible appliances for the public operating mode according to manufacturer's written instructions and Authority Having Jursidiction.
6. Factory-authorized service representative shall prepare the "Fire Alarm System Record of Completion" in the "Documentation" Section of the "Fundamentals of Fire Alarm Systems" Chapter in NFPA 72 and the "Inspection and Testing Form" in the "Records" Section of the "Inspection, Testing and Maintenance" Chapter in NFPA 72.

E. Reacceptance Testing: Perform reacceptance testing to verify the proper operation of added or replaced devices and appliances.

F. Fire-alarm system will be considered defective if it does not pass tests and inspections.

G. Prepare test and inspection reports.

H. Maintenance Test and Inspection: Perform tests and inspections listed for weekly, monthly, quarterly, and semiannual periods. Use forms developed for initial tests and inspections.

I. 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.

3.6 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain fire-alarm system.

END OF SECTION 28 07 21

Louisa May Alcott
Community School

SECTION 28 07 30 – ACCESS CONTROL SYSTEM

PART 1 - GENERAL

1.01 SYSTEM DESCRIPTION

A. The Access Control System shall be fully integrated and installed as a complete package by the Access/Security Control Contractor. The SMS shall be able to provide for and integrate the following subsystems:

1. Integrated Access Control.
2. Alarm Monitoring.
3. Associated Access Control and Alarm Equipment Control.
4. Multiple Language Operation
5. Access Initiated and Event Initiated Control
6. Integrated Video Badging System
7. Workstation and associated equipment as required.

B. The SMS shall be based upon a distributed system of fully intelligent, stand-alone controllers, operating in a multi-tasking, multi-user environment on a true peer-to-peer, token passing Local Area Network (LAN). The SMS shall be capable of monitoring, recording, and displaying card access activity and supervised alarm inputs/outputs on a continuous, real time basis. Each installation shall comply with local, state, and federal code requirements as applicable.

C. The SMS shall be capable of providing access control and alarm monitoring capabilities for large and small facilities. The system shall be user friendly, providing a user interface that allows for training of non- technical personnel to effectively operate and administer the system.

D. The SMS shall be designed to provide a centralized location with the ability to monitor, control, view, and communicate from a secure location within a facility.

E. System expansion capability: Minimum 25% over specified requirements.

1.02 SYSTEM CAPABILITIES

A. The following functional capabilities are considered essential for the Security Management System described in this specification:

1. Integrated Access Control
2. Door Control
3. First Key Auto Unlock
4. Anti-Passback control
5. Alarm Assessment (Instructions)
6. Database Security And Encryption
7. Maps Displaying Alarm Points
8. If/Then/and/or/not functions
9. Time Scheduled Events
10. Access Control initiated events
11. Calculations
12. Windows Based, Mouse oriented operations
13. Alarm processing from remote locations
14. processing of Access Control functions for remote locations
15. Integrated Video Badging and user configurable, automatic image verification

16. Ability to Import and Export cardholder data
17. Comprehensive User Definable Reports for transactions, alarms, messages and events
18. Comprehensive User Definable Database Reports
19. Comprehensive User Definable Archiving
20. Visitor Management
21. Two Man Rule
22. Support for OPC, DDE and ODBC technologies
23. Ability to be WEB enabled

1.03 RELATED WORK

A. Door hardware. Not specifically covered under this specification.

B. Wiring / Cable Specifications. NOTE: Coaxial wiring for data communications is not acceptable.

1. Wiring requirements are indicated on the drawings. All wiring shall in strict accordance with all manufacturers' recommendations.
2. All other cable is to meet the following requirements as outlined below:
   a. UL Listed
   b. NEC approved
   c. Plenum rated where required
   d. All cabling shall be shielded unless specified otherwise by a card access manufacturer.
   e. As a minimum, standard 18 AWG cable shall be installed unless in direct conflict with manufacturers specifications
   f. All cabling used in the implementation of systems integration shall be in accordance with the recommendations of the manufacturer.
3. Provide specialist personnel for the complete wiring installation. Provide cables, conduits, cable tray and ancillary equipment necessary to complete the installation. Refer to Division 26 for additional requirements.
4. The installation contractor must be licensed in the State of Utah as a Burglar Alarm Company. The installation contractor must be an authorized dealer of the access control system. The installation contractor must be a licensed Electrical Contractor in the State of Utah.

C. Grounding

1. Take particular attention to the grounding of equipment cases and shielded cables to eliminate noise interference and avoid electrical loops. Provide shielded cable for all communications cabling. Correctly terminate shields at ground bars and connect to the main building ground or as specified by the manufacturer.
   a. Insulate all incoming or outgoing shielded cables from control cabinet casings.
   b. Provide suitable terminals, where grounding of cable shields is required.
   c. Make provision of a through connection of cable shields for through connected communications cables.

D. Programmers

1. Experienced in the field of security services to suit the application. Carry out the complete design and programming of the installation in the local office of the system supplier.

E. System Support

1. System support: Provide a guarantee of system support for a minimum period of six years after final completion, including provision for technical support, hardware, and spare parts. Demonstrate that the manufacturer's previous systems have not been made obsolete and that the manufacturer is committed to total and complete backward compatibility.

1.04 SUBMITTALS

A. Provide a submittal for approval prior to commencement of installation and training to include:

1. English language description of system operation.
2. Logical flow charts.
3. Building floor plans indicating all secured portals and intrusion devices.
4. Input/output point schedules.
5. A copy of the database put into logical groups that represent how information will be displayed to the user.
6. All graphics.
7. Floor plans showing location of all controllers and sensors.
8. Co-ordination drawings showing interface terminal numbers and cross-referenced wire numbers for all connections between the SMS and other equipment.
9. Details of all readers, control devices, and sensors.
10. Full details of each control station including equipment and wiring diagrams and terminal layouts.
11. Fully detailed wiring diagrams for the entire security control, monitoring and electrical cabling installation.

1.05 MATERIALS

A. Unless indicated otherwise, furnish and install at locations shown, the specified equipment to provide a completely operational Access Control/Security Management system. The following list of main items of the installation shall not be considered to be all-inclusive:

1. Door hardware and accessories
2. Readers
3. Credential Cards (Minimum of 500)
4. Monitors
5. Distributed Control Units (DCU's) – Main Controller
6. Door Processing Units (DPU's) – Main Door Controllers
7. Card Printers
8. Alarm relays
9. Miscellaneous cable, wire, associated connectors, and hardware
10. Power supplies
11. All materials and equipment shall be standard, regularly manufactured equipment.
12. All systems and components shall be thoroughly tested and proven in actual field use.
13. All system main control components shall be from one manufacturer.

1.06 Quality Assurance

A. System manufactures shall have implemented a Quality System that complies with the ISO9001 model. Factory owned System Integrators shall be able to exhibit a commitment to gaining ISO9002 accreditation or shall have an existing accreditation in place. A

factory owned office that is also ISO 9001/ISO 9002 certified or an authorized distributor of the manufacturer shall install the SMS equipment. Any other installers will not be acceptable bidders for this project.

B. Evidence of the Quality System Audits may be requested.

1.07 WARRANTY PERIOD

A. General: Provide maintenance of the system during the warranty period with the following minimum provisions:

1. Notify building owner's representative prior to performing any maintenance work.
2. The designated representative to monitor and report on equipment performance and service history, and to be a liaison with the building owner.
3. Conditions: The warranty shall cover any defects in materials and workmanship including installation and programming which shall be found during the term. This shall include any deficiencies in installation standards vis-à-vis the specifications.
4. Response: The contractor shall respond to calls for warranty service within eight working hours. Emergency service shall be obtainable within four hours of notification by the Owner. Emergency service shall be obtainable on a 24 hours basis, seven days per week.
5. Qualifications: The contractor shall utilize factory-trained technicians located within 100 miles of the job site.

B. Extended service agreement:

1. Provide a renewable annual maintenance agreement. The agreement shall provide for periodic inspections and maintenance of repair items. The agreement shall at a minimum provide for all of the terms and conditions of the warranty.

1.08 OPERATION AND MAINTENANCE DATA

A. Operation Manuals: The contractor shall deliver six composite “Systems Operation and Maintenance” manuals in three-ring binder form or bound handbook form, sized to hold the material below. Each manual shall contain, but not be limited to:

1. A Statement of Guarantee including date of termination and the name and phone number of the person to be called in the event of equipment failure.
2. A set of operational procedures for the overall system that includes all required customer activities that allow for customer operation of all system capabilities. This procedure shall fully address all customer- established system operating objectives.
3. Individual factory-issued manuals, containing all technical information on each piece of equipment installed. In the event such manuals cannot be obtained from a manufacturer, it shall be the responsibility of the contractor to compile and include them. Advertising brochures or operational instructions shall not be used in lieu of the required technical manuals and information. All manuals shall be printed to ensure their permanence. No “blue line” type of reproduction is acceptable.
4. Provide six sets of manuals to include:
   a. Updated functional specification.
   b. Specification sheets and technical brochures on all equipment.
   c. Fault finding literature.
   d. Listings and description of application programs.
   e. Programmer's manual.
   f. Operator's manual including schedules of alarms, parameters, status,

analog indicators, circuit diagrams, etc.
g. Drawings.
h. Commissioning data.

B. Maintenance Pricing: Provide a SEPARATE, fixed price for comprehensive maintenance of the complete SMS system from date of completion of the Warranty Period for the required period.

C. The Owner has the option of accepting or rejecting the proposal. The proposal will be used to evaluate the successful bidder. The proposal provides:

1. Preventative or routine maintenance as required after the Warranty Period.
2. All labor and materials for repair or replacement of defective equipment as required after Warranty Period
3. 24 hour, seven days a week breakdown service with a maximum of 24 hours response time.
4. A designated representative to monitor and report on equipment performance and service history and to be a liaison with the building owner.
5. Continuity of service personnel.
6. Provision and installation of software revisions.

1.09 OWNER'S TRAINING

A. The contractor shall supply personnel to train key customer personnel in the operation and maintenance of the installed system. The training program shall be designed to provide a comprehensive understanding and basic level of competence with the system. It shall be sufficiently detailed to allow customer personnel to operate the system independent of any outside assistance.

B. On-line context-sensitive HELP screens shall be incorporated into the system to further facilitate training and operation.

C. The training plan shall include detailed session outlines and related reference materials. The customer personnel shall be able to utilize these materials in the subsequent training of their co-workers.

D. Training time shall not be less than a total of 16 hours, and shall consist of:

1. 8 hours during normal day shift periods for system operators. Specific schedules shall be established at the convenience of the customer.
2. 8 hours of system training shall be provided to customer supervisory personnel so that they are familiar with system operation.
3. The specified training schedule shall be coordinated with the customer and will follow the training outline submitted by the contractor as part of the submittal process.

1.10 EXTRA MATERIALS

A. Based upon the contractor's and the manufacturer's experience with the equipment's performance history, the contractor shall submit a final spares list for all functions for this system. This list shall be based upon a philosophy of maintaining a central system operation with a simple remove/replace capability. The final spares list shall be developed as a result of a joint customer/contractor review of the recommended list during the installation phase. Submit this final recommended spares list for approval prior to system completion, so that spares are available upon activation.

B. As a minimum, provide:

1. Adequate response time
2. Adequate spare parts, to complete repairs within 48 hours of arrival at the job site.

PART 2 - PRODUCTS

2.01 GENERAL

A. S2 / Lenel (Basis of Design)
B. Avigilon
C. RBH

PART 3- EXECUTION

3.01 INSTALLATION

A. The installation contractor must be an authorized dealer of the access control system. The installation contractor must be a licensed Electrical Contractor in the State of Utah.

B. Install all devices in locations as shown on the drawings in accordance with standard industry practice.

C. Install and adequately support fixed wiring throughout the installation. For cabling routes not specified in detail, submit a proposed route layout. Install bulk cable runs from switchboards to SMS panels in metal ducts.

D. Handling cables: Handle cables to avoid damage to insulation and sheathing. Report any damage and replace or repair damaged cable as directed.

E. Straight-through joints: Unless unavoidable due to length or difficult installation conditions, run cables for their entire route length without intermediate straight-through joints. Where straight-through joints are used contain within a junction box arranged so that they are accessible after installation.

F. Tagging: Identify all cables at each end and at crowded intermediate points by means of stamped, non-ferrous tags, clipped around each cable.

G. Segregation: Physically segregate data cabling from power and SMS input/out cabling and mains cabling from all other cabling.

H. Panels

1. Install panels and controllers within a dedicated metal enclosure.
2. Documentation: Provide plastic fade-free points list in a pocket. Include terminal numbers, point addresses and short and long descriptions.
3. Small point controllers: Install adjacent to the controlled device, accessible for maintenance. Provide suitable enclosure.

3.02 PRECONSTRUCTION MEETING:

A. Attend a Preconstruction Meeting with the Owner to review installation standards prior to doing any work.

3.03 WIRING METHODS

A. Install cables in raceways and cable trays except within consoles, cabinets, desks, counters, and accessible lay-in tile accessible ceilings. Install cabling with horizontal and vertical cable guides in telecommunications spaces with terminating hardware and interconnection equipment. Where cables are routed in accessible lay-in tile suspended ceilings, secure and support cables with J-hooks a minimum of 8 inches (200 mm) above ceilings and not more than 60 inches (1524 mm) apart; cable shall not be run through structural members or in contact with pipes, ducts, or other potentially damaging items. Install cables in open ceilings (finished and unfinished) in raceways. Where raceways are installed in finished ceilings, paint raceways to match the color of the surrounding surface.

1. Install plenum cable in environmental air spaces, including plenum ceilings.
2. Comply with requirements in Section 260110 "Conduit Raceways." Minimum raceway size is 1".
3. Comply with requirements in Section 260111 "Cable Trays."

B. Wiring within Enclosures:

1. Bundle, lace, and train conductors to terminal points with no excess and without exceeding manufacturer's limitations on bending radii.
2. Install lacing bars and distribution spools.
3. Install conductors parallel with or at right angles to sides and back of enclosure.

3.04 INSTALLATION OF CABLES

A. Comply with NECA 1.

B. General Requirements for Cabling:

1. Comply with TIA/EIA-568-B.1.
2. Comply with BICSI ITSIM, Ch. 6, "Cable Termination Practices."
3. Make terminations only at indicated outlets, terminals, cross-connects, and patch panels.
4. Cables may not be spliced. Secure and support cables at intervals not exceeding 30 inches (760 mm) and not more than 6 inches (150 mm) from cabinets, boxes, fittings, outlets, racks, frames, and terminals.
5. Install lacing bars to restrain cables, to prevent straining connections, and to prevent bending cables to smaller radii than minimums recommended by manufacturer.
6. Bundle, lace, and train conductors to terminal points without exceeding manufacturer's limitations on bending radii, but not less than radii specified in BICSI ITSIM, "Cabling Termination Practices" Chapter. Install lacing bars and distribution spools.
7. Do not install bruised, kinked, scored, deformed, or abraded cable. Do not splice cable between termination, tap, or junction points. Remove and discard cable if damaged during installation and replace it with new cable.
8. Cold-Weather Installation: Bring cable to room temperature before dereeling. Heat lamps shall not be used for heating.

9. In the communications equipment room, install a 10-foot- (3-m-) long service loop on each end of cable.
10. Pulling Cable: Comply with BICSI ITSIM, Ch. 4, "Pulling Cable." Monitor cable pull tensions.

C. UTP Cable Installation:

1. Comply with TIA/EIA-568-B.2.
2. Do not untwist UTP cables more than 1/2 inch (12 mm) from the point of termination to maintain cable geometry.

D. Group connecting hardware for cables into separate logical fields.

E. Separation from EMI Sources:

1. Comply with BICSI TDMM and TIA-569-B for separating unshielded copper voice and data communication cable from potential EMI sources, including electrical power lines and equipment.
2. Separation between open communications cables or cables in nonmetallic raceways and unshielded power conductors and electrical equipment shall be as follows:

   a. Electrical Equipment Rating Less Than 2 kVA: A minimum of 5 inches (127 mm).
   b. Electrical Equipment Rating between 2 and 5 kVA: A minimum of 12 inches (300 mm).
   c. Electrical Equipment Rating More Than 5 kVA: A minimum of 24 inches (610 mm).

3. Separation between communications cables in grounded metallic raceways and unshielded power lines or electrical equipment shall be as follows:

   a. Electrical Equipment Rating Less Than 2 kVA: A minimum of 2-1/2 inches (64 mm).
   b. Electrical Equipment Rating between 2 and 5 kVA: A minimum of 6 inches (150 mm).
   c. Electrical Equipment Rating More Than 5 kVA: A minimum of 12 inches (300 mm).

4. Separation between communications cables in grounded metallic raceways and power lines and electrical equipment located in grounded metallic conduits or enclosures shall be as follows:

   a. Electrical Equipment Rating Less Than 2 kVA: No requirement.
   b. Electrical Equipment Rating between 2 and 5 kVA: A minimum of 3 inches (76 mm).
   c. Electrical Equipment Rating More Than 5 kVA: A minimum of 6 inches (150 mm).

5. Separation between Communications Cables and Electrical Motors and Transformers, 5 kVA or HP and Larger: A minimum of 48 inches (1200 mm).
6. Separation between Communications Cables and Fluorescent Fixtures: A minimum of 5 inches (127 mm).

3.05 FIRESTOPPING

A. Comply with requirements in Section 078413 "Penetration Firestopping."

B. Comply with TIA-569-B, Annex A, "Firestopping."

C. Comply with BICSI TDMM, "Firestopping Systems" Article.

3.06 GROUNDING

A. Install grounding according to BICSI TDMM, "Grounding, Bonding, and Electrical Protection" Chapter.

B. Comply with J-STD-607-A.

C. Locate grounding bus bar to minimize the length of bonding conductors. Fasten to wall allowing at least 2-inch (50-mm) clearance behind the grounding bus bar. Connect grounding bus bar with a minimum No. 4 AWG grounding electrode conductor from grounding bus bar to suitable electrical building ground.

D. Bond metallic equipment to the grounding bus bar, using not smaller than No. 6 AWG equipment grounding conductor.

3.07 TRANSMISSION SYSTEMS

A. The SMS shall utilize the above LAN architecture to allow all of the Control Units to share data as well as to globalize alarms. The Controller LAN shall be based upon a peer-to-peer, token passing technique with a data speed of not less than 19.2 Kb. Systems which require a "master" communications controller or network manager for the Controller LAN are not acceptable.

B. To ensure high throughput, data transmission shall use "packetized" communization techniques, such that dozens of "messages" are contained in each "packet".

C. The "turnaround time" for a global point to be received by any node, including operator stations, shall be less than three seconds.

D. Fiber Optic Pathways: If required, fiber optic media shall be used between buildings for the Controller LANs. Wherever the optical fiber enters or leaves the building, provide a fiber to hard copper interface device. The FOI shall regenerate data prior to transmitting this data to either the fiber or hard copper channels, so as not to result in the degradation of signal and to minimize the accumulation of errors between multiple FOIs. The FOI shall include "jabber" protection, such that continuous data from a defective component will not destroy communications on the LAN. Provide visual indication of receiving and transmitting data activity on the hardwired drop. Provide visual indication of data transmission on the fiber media, jabber presence on fiber and hard copper channels, and bad signal quality on the hard copper channel.

3.08 COMMUNICATIONS

A. Utilize an established LAN or other communication standard to link all SMS equipment.

B. Technique: Token Passing network for Controller LAN, Polled for Small Point & Application Specific Controllers.

C. Configuration: A break in the communication path of the Controller LAN shall be announced as an alarm and shall automatically initiate a Controller LAN reconfiguration such that the resulting sections of the Controller LAN continue to function as separate LANs. No loss of control shall result from such a break in the Controller LAN.

D. Data corruption: Check all data and retransmit if corruption has occurred. Provide

adequate buffering to ensure that important data is not lost.

E. Commercial LAN: Workstations on the Controller LAN may also reside on a higher tier "commercial" LAN. This "commercial" LAN shall be based upon Ethernet, and comply with IEEE 802.3 standards. Where a "commercial" LAN is implemented, it shall be possible to connect multiple Controller LANs together, with global data sharing across this commercial LAN.

F. An operator at a workstation on the "commercial" LAN may connect to any other workstation on the "commercial" LAN as if the operator were sitting at the other workstation.

G. Alarms and special event notices shall be routed to different workstations on the "commercial" LAN-based upon time of day, and day of the week.

H. Operator password assignment shall be available on both a system-wide basis and a workstation by workstation basis.

3.09 TESTING AND COMMISSIONING

A. GENERAL

1. The contractor shall perform all tests submitted in the “Test Procedure” section as outlined in the specification.
2. Provide a program for the testing and commissioning procedure. Use a qualified representative of the SMS supplier to co-ordinate testing and present at all tests and training courses and remain on-site until the SMS is fully operational.

B. FACTORY TESTING

1. Procedure: Submit procedure for factory test at least two weeks prior to the test.
2. Demonstration: Demonstrate each control loop including all calculations and global functions. Simulate analog values with potentiometers if required. Allow for attendance by three persons nominated by the Owner.
3. After test: Submit summary of results and necessary modifications.

C. SITE TESTING AND COMMISSIONING

1. Carry out the following:
   a. Testing and commissioning of all SMS panels separately before connecting to the network.
   b. Attendance at the testing of all equipment that interfaces to the SMS and confirmation of the operation of such equipment from the SMS interface terminals.
   c. Testing and calibration checks of all installed controllers, actuators and sensors by actual operation of the devices.
   d. Testing of all field wiring from terminals to field interface terminal strips.
   e. Testing and commissioning of all power supplies and batteries.
   f. Verification of communication to remote systems.
   g. Testing of the operation of each control point from the operator's workstation (if supplied) and verification of the status of all points and alarm functions on graphic displays.
2. Demonstrate the following:
   a. Operation of each control loop.
   b. Calibration of sensors.
   c. Globally transferred information such as alarms.

d. Detection and action of all alarm conditions.
e. Communications with PC workstations.
f. Time schedules and after-hours operation.
g. Mapping of system points to operator's workstation(s).
h. Operator's workstation software.
i. Power fail re-start.
j. Essential power mode operation.
k. Fire mode of operation.
l. Telecommunication facilities.

D. FINAL ACCEPTANCE TEST:

1. After the testing report and as built drawings have been approved by the customer's representative, the completed system shall be tested in the presence of the customer's representative.
2. Acceptance of the system shall require a demonstration of the stability of the system. Should major equipment failure occur, the contractor shall replace or repair component (s). This test shall not start until the customer has obtained 30 days beneficial use of the system.

3.10 NOTICE OF COMPLETION

A. When the final acceptance test described above has been satisfactorily completed, the contractor shall issue a letter of completion to the customer indicating the date of such completion. The notice of completion shall be recorded by the contractor upon receipt of the customer completion letter. This date of record shall be the start of the one-year guarantee period.

END OF SECTION 27 07 30

SECTION 28 23 00 – VIDEO SURVEILLANCE

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section includes a video surveillance system consisting of cameras and data transmission cabling. Provide Communications Horizontal Cabling for all video surveillance cameras. Refer to Section 27 1500, “Communications Horizontal Cabling”.

B. Video management software.

1.3 DEFINITIONS

A. AGC: Automatic gain control.

B. BNC: Bayonet Neill-Concelman - type of connector.

C. B/W: Black and white.

D. CCD: Charge-coupled device.

E. FTP: File transfer protocol.

F. IP: Internet protocol.

G. LAN: Local area network.

H. MPEG: Moving picture experts’ group.

I. NTSC: National Television System Committee.

J. PC: Personal computer.

K. PTZ: Pan-tilt-zoom.

L. RAID: Redundant array of independent disks.

M. TCP: Transmission control protocol - connects hosts on the Internet.

N. UPS: Uninterruptible power supply.

O. WAN: Wide area network.

1.4 PERFORMANCE REQUIREMENTS

A. Seismic Performance: Video surveillance system shall withstand the effects of earthquake motions determined according to ASCE/SEI 7.

1. The term "withstand" means "the unit will remain in place without separation of any parts from the device when subjected to the seismic forces specified and the unit will be fully operational after the seismic event."

1.5 ACTION SUBMITTALS

A. Product Data: For each type of product indicated. Include dimensions and data on features, performance, electrical characteristics, ratings, and finishes.

B. Shop Drawings: For video surveillance. Include plans, elevations, sections, details, and attachments to other work.

1. Detail equipment assemblies and indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
2. Functional Block Diagram: Show single-line interconnections between components for signal transmission and control. Show cable types and sizes.
3. Wiring Diagrams: For power, signal, and control wiring.

C. Equipment List: Include every piece of equipment by model number, manufacturer, serial number, location, and date of original installation. Add pretesting record of each piece of equipment, listing name of person testing, date of test, set points of adjustments, name and description of the view of preset positions, description of alarms, and description of unit output responses to an alarm.

1.6 INFORMATIONAL SUBMITTALS

A. Seismic Qualification Certificates: For video surveillance, cameras, camera-supporting equipment, accessories, and components, from manufacturer.

1. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.
2. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.
3. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.

B. Field quality-control reports.

C. Warranty: Sample of special warranty.

1.7 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For cameras, power supplies, infrared illuminators, monitors, videotape recorders, digital video recorders, video switches, and control-station components to include in emergency, operation, and maintenance manuals. In addition to items specified in Section 017823 "Operation and Maintenance Data," include the following:

1. Lists of spare parts and replacement components recommended to be stored at the site for ready access.

B. Map: Facilities Project Manager will provide with a pdf map of the building to the Installer. Installer shall add labels to the map per Owner's standards, identifying the location of each camera, and return completed map in electronic pdf form back to the Project Manager.

C. Spreadsheet: Facilities Project Manager will provide with an Excel spreadsheet to the Installer. Installer shall fill out all requested information and return electronic spreadsheet file to back to the Project Manager.

1.8 QUALITY ASSURANCE

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

B. Comply with NECA 1.

C. Comply with NFPA 70.

1.9 PROJECT CONDITIONS

A. Environmental Conditions: Capable of withstanding the following environmental conditions without mechanical or electrical damage or degradation of operating capability:

1. Interior, Controlled Environment: System components installed in air-conditioned interior environments shall be rated for continuous operation in ambient temperatures of 36 to 122 deg F (2 to 50 deg C) dry bulb and 20 to 90 percent relative humidity, noncondensing. Use NEMA 250, Type 1 enclosures.
2. Interior, Uncontrolled Environment: System components installed in non-air-conditioned interior environments shall be rated for continuous operation in ambient temperatures of 0 to 122 deg F (minus 18 to plus 50 deg C) dry bulb and 20 to 90 percent relative humidity, noncondensing. Use NEMA 250, type 12 enclosures.
3. Exterior Environment: System components installed in locations exposed to weather shall be rated for continuous operation in ambient temperatures of minus 30 to plus 122 deg F (minus 34 to plus 50 deg C) dry bulb and 20 to 90 percent relative humidity, condensing. Rate for continuous operation when exposed to rain as specified in NEMA 250, winds up to 85 mph (137 km/h) and snow cover up to 24 inches (610 mm) thick. Use NEMA 250, Type 3R enclosures.

PART 2 - PRODUCTS

2.1 MANUFACTURES

A. Axis (Basis of Design)
B. Avigilon
C. Hanwah

D. Installer is to be an authorized reseller/integrator and must be certified for the products specified.

E. Bidding Requirements: All integrators bidding video surveillance shall break-out video surveillance separately from all other systems including fire alarm, access control, and intrusion detection. Integrators not complying with this requirement may be disqualified.

2.2 SYSTEM REQUIREMENTS

A. Surveillance cameras and system shall be IP-based with transmission via a computer network and the Internet.

B. Surge Protection: Protect components from voltage surges originating external to equipment housing and entering through power, communication, signal, control, or sensing leads. Include surge protection for external wiring of each conductor's entry connection to components.

1. Minimum Protection for Power Connections 120 V and More: Auxiliary panel suppressors complying with requirements in Section 26 0289, "Surge Protective Devices."

2. Minimum Protection for Communication, Signal, Control, and Low-Voltage Power Connections: Provide UL 497 Listed primary solid-state protector for all conductive communications paths entering or leaving a building as close as possible, but no more than 50 feet, from the cables' point of entrance.

C. Tamper Protection: Tamper switches on enclosures, control units, pull boxes, junction boxes, cabinets, and other system components shall initiate a tamper-alarm signal when unit is opened or partially disassembled. Control-station, control-unit alarm display shall identify tamper alarms and indicate locations.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine pathway elements intended for cables. Check raceways and other elements for compliance with space allocations, installation tolerance, hazards to camera installation, and other conditions affecting installation.

B. Examine roughing-in for LAN, WAN, and IP network before device installation.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 WIRING

A. Install cables in raceways and cable trays except above lay-in tile accessible ceilings. Install cables in raceway where routed in consoles, cabinets, desks, and counters. Install cabling with horizontal and vertical cable guides in telecommunications spaces with terminating hardware and interconnection equipment. Where cables are routed above accessible lay-in tile suspended ceilings, secure and support cables with J-hooks a minimum of 8 inches (200 mm) above ceilings and not more than 60 inches (1524 mm) apart; cable shall not be run through structural members or in contact with pipes, ducts, or other potentially damaging items. Install cables in open ceilings (finished and unfinished) in raceways. Where raceways are installed in finished ceilings, paint raceways to match the color of the surrounding surface.

1. Install plenum cable in environmental air spaces, including plenum ceilings.

2. Comply with requirements in Section 26 0110 “Conduit Raceways.” Minimum raceway size is ¾”.
3. Comply with requirements in Section 26 0536 “Cable Trays.”

B. Conceal raceway and cables except in unfinished spaces.

C. In open ceilings and unfinished spaces, install wiring in exposed raceway.

D. Refer to Section 26 0110, “Conduit Raceways” for conduit raceways and Section 26 0536 “Cable Trays”.

E. Wiring within Enclosures: Bundle, lace, and train conductors to terminal points with no excess and without exceeding manufacturer's limitations on bending radii. Provide and use lacing bars and distribution spools.

F. Splices, Taps, and Terminations: For power and control wiring, use numbered terminal strips in junction, pull, and outlet boxes; terminal cabinets; and equipment enclosures. 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.

G. For LAN connection and copper communication wiring, comply with Section 27 1500 "Communications Horizontal Cabling". Use UL-listed plenum cable throughout the entire system.

H. Grounding: Provide independent-signal circuit grounding recommended in writing by manufacturer.

3.3 VIDEO SURVEILLANCE SYSTEM INSTALLATION

A. Install cameras and infrared illuminators level and plumb.

B. Install cameras with 84-inch- (2134-mm-) minimum clear space below cameras and their mountings or as otherwise indicated on drawings. Change type of mounting to achieve required clearance.

C. Identify system components, wiring, cabling, and terminals according to Section 27 1500 "Communications Horizontal Cabling."

D. Add cameras to VMS Software:

1. Work directly with the Owner’s IT Department to ensure cameras are configured in Milestone according to Owner’s Standards.
2. Sign-off in writing, with the Owner’s Facilities Project Manager and personnel that all camera views are acceptable.

3.4 FIELD QUALITY CONTROL

A. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect, test, and adjust components, assemblies, and equipment installations, including connections.

B. Perform tests and inspections.

1. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect components, assemblies, and equipment installations, including connections, and to assist in testing.

C. Tests and Inspections:

1. Inspection: Verify that units and controls are properly installed, connected, and labeled, and that interconnecting wires and terminals are identified.
2. Pretesting: Align and adjust system and pretest components, wiring, and functions to verify that they comply with specified requirements. Conduct tests at varying lighting levels, including day and night scenes as applicable. Prepare video-surveillance equipment for acceptance and operational testing as follows:

    a. Prepare equipment list described in "Informational Submittals" Article.
    b. Set back-focus of fixed focal length lenses. At focus set to infinity, simulate nighttime lighting conditions by using a dark glass filter of a density that produces a clear image. Adjust until image is in focus with and without the filter.
    c. Set and name all preset positions; consult Owner's personnel.
    d. Set sensitivity of motion detection.
    e. Connect and verify responses to alarms.
    f. Verify operation of control-station equipment.

3. Test Schedule: Schedule tests after pretesting has been successfully completed and system has been in normal functional operation for at least 14 days. Provide a minimum of 10 days' notice of test schedule.
4. Operational Tests: Perform operational system tests to verify that system complies with Specifications. Include all modes of system operation. Test equipment for proper operation in all functional modes.

D. Video surveillance system will be considered defective if it does not pass tests and inspections.

E. Prepare test and inspection reports.

F. Update cameras with the latest recommended firmware.

G. Label physical camera according to Owner’s Standards.

3.5 ADJUSTING

A. Occupancy Adjustments: When requested within 12 months of 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. Tasks shall include, but are not limited to, the following:

1. Check cable connections.
2. Check proper operation of cameras and lenses. Verify operation of auto-iris lenses and adjust back-focus as needed.
3. Adjust all preset positions; consult Owner's personnel.
4. Recommend changes to cameras, lenses, and associated equipment to improve Owner's use of video surveillance system.
5. Provide a written report of adjustments and recommendations.

3.6 CLEANING

A. Clean installed items using methods and materials recommended in writing by manufacturer.

B. Clean video-surveillance-system components, including camera-housing windows and lenses.

3.7 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain video-surveillance equipment.

3.8 TRAINING

A. Basic end-user training will be provided for all surveillance system equipment and software at no additional cost.

B. Provide information to the Owner regarding surveillance system equipment training along with respective details and associated costs.

END OF SECTION 28 23 00

SECTION 011001 – TECHNICAL SPECIFICATIONS INCLUSION DOCUMENT

The Technical Specification and Standard Plan Documents that govern the construction of the **Louisa May Alcott Community School in Mapleton, Utah** are listed below as well as the improvements they govern:

Mapleton City Standards and Specifications – Contact Mapleton City for Current Edition

- **This Document shall govern improvements within the Mapleton City Road Right-of-Way or other improvements that may be owned or operated by Mapleton City.**

American Public Works Association (APWA)

Manual of Standard Specifications and Manual of Standard Plans 2026 Edition

- **This Document shall govern the On-Site Private Improvements as identified on the Plans. The appropriate Sections of APWA Manual (Orange Book) are printed and included herein.**

The APWA Divisions listed below are the Divisions that apply to this Project. Also, included in this Document by Division is a list of each of the individual Sections that are appropriate and that apply to this Project, they are printed and included herein in this Document for use of BIDDER.

DIVISION 02 - EXISTING CONDITIONS
DIVISION 03 - CONCRETE
DIVISION 31 - EARTHWORK
DIVISION 32 - EXTERIOR IMPROVEMENTS
DIVISION 33 - UTILITIES

The APWA Manual of Standard Specifications and Plans that are included herein should be used as appropriately in the preparation of the Bid for the **Louisa May Alcott Community School** new charter school campus. It is the Bidders responsibility to utilize all these Documents and to know and understand them as they apply to this Project and to include in their Bid any costs associated with complying with the provisions provided therein.

It shall be required that these Documents be on site at all times during Construction.

The APWA Manual is available at the following locations listed below if needed:

For Purchase at:
Utah LTAP Center
Utah State University
8205 Old Main Hill
Logan, Utah 84322-8205
Phone Number (800) 822-8878 or (435) 797-2931

On-Line at: http://www.apwastore.net/viewcategory.php?groupid=0

END OF SECTION

T A B L E O F C O N T E N T S

DABS Distribution Center Expansion

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DIVISION 02

EXISTING CONDITIONS

SECTION 02 41 13
SELECTIVE SITE DEMOLITION

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Remove site structural and site utility items and dispose of them off site.

B. Salvage.

1.2 PAYMENT PROCEDURES

A. Payment for structures or obstructions that are not designated for removal and disposal in the Bid documents, that cannot be removed with equipment reasonably expected to be used in the work without cutting, drilling, or blasting, will be paid for **by Change Order**.

B. Backfilling depressions left because of demolition work will not be measured or paid for separately except as provided in the preceding paragraph.

PART 2 PRODUCTS Not Used

PART 3 EXECUTION

3.1 PREPARATION

A. Review all work procedures with ENGINEER and with representatives of any utility in the work zone.

B. Locate and preserve all active utilities which are to remain in service.

C. Implement traffic control plan requirements, Section 01 55 26.

3.2 PROTECTION

A. Protect irrigation systems.

B. Protect structures to be removed and their contents from vandalism and theft.

C. Protect trees:

1. Avoid or minimize damage to trees and tree roots.
2. Provide certified arborist observation of root cuts larger than four (4) inches diameter. Roots provide anchorage, storage of energy, and absorption and conduction of water and mineral elements. Loss of root connection affects health and stability of tree and safety of people and property. Notify ENGINEER of such root cut.

D. Repair or replace damage at no additional cost to OWNER.

3.2 **STRUCTURE DEMOLITION**

A. Remove structures and incidentals such as foundations, fences, outbuildings, etc.

B. Remove foundation walls at least two (2) feet below finished grade or two (2) feet below natural ground surface. Remove floor slab or break it into pieces no larger than three (3) feet square.

C. Backfilling and compaction of excavations for structures, Section 31 23 23.

D. Building components, Section 02 41 19.

3.3 **PIPELINE DEMOLITION**

A. General:

1. Abandoned pipelines not to be salvaged are considered as incidental excavation work, Section 31 23 16.
2. Do not damage pipe or structures that remain in service or are to be salvaged for OWNER.

B. Gravity Pipe Demolition:

1. Plug abandoned pipe with a permanent, water-tight concrete plug extending into the abandoned pipe at least two (2) feet.
2. Seal openings in walls of remaining manholes, catch basins, or structures with water-tight plugs.

C. Pressure Pipe Demolition:

1. Coordinate demolition with ENGINEER and agency owning the utility pipe.
2. Plug abandoned pipe with a permanent water-tight plug.
3. Cap and restrain the active pipe with a blind flange or equivalent type of plug.
4. For service line demolition or abandonment, disconnect the line from the mainline and shut off the corporation stop.

3.4 **BRIDGE AND ABUTMENT DEMOLITION**

A. Remove existing bridges and abutments indicated.

B. Remove structures so that no remaining portion is closer than three (3) feet to any water course or closer than two (2) feet to the Subgrade and Embankment surface, or within two (2) feet of the natural ground surface.

C. Remove structures so compacted backfill can be provided as required in backfilling operation, Section 31 23 23.

3.5 **BURIED FUEL TANK DEMOLITION**

A. Remove buried fuel storage tanks and dispose of tank contents in accordance with Laws and Regulations.

B. Do not spill fuel on Subgrade.

C. Comply with the local authority having jurisdiction over fuel tank

removals.

3.6 MISCELLANEOUS DEMOLITION

A. Remove miscellaneous structures and obstructions or cover them with backfill if the result meets the following requirements:

1. Backfill is stable.
2. Burial does not interfere with construction.
3. Permission to do so is obtained from ENGINEER.
4. No remaining portion is within two (2) feet of the final ground surface contours.

3.7 SALVAGE

A. Salvage designated equipment and materials for OWNER.

B. All other material becomes the property of CONTRACTOR unless such materials are not owned by OWNER.

END OF SECTION

SECTION 02 41 14
PAVEMENT REMOVAL

PART 1 GENERAL

1.1. **SECTION INCLUDES**

A. Remove roadway Pavement.

B. Remove curb, gutter, sidewalk, Driveway Approach, waterway and similar flat work.

1.2 **MEASUREMENT PROCEDURES**

A. Double saw cutting required for pavement removal or T-patches will not be measured or paid for separately.

1.3 **REFERENCES**

A. **APWA (Utah) Standards**:

Plan 256 Concrete pavement patch

1.4 **SUBMITTALS**

A. Traffic control plan, Section 01 55 26.

PART 2 PRODUCTS Not Used

PART 3 EXECUTION

3.1 **PREPARATION**

A. Implement traffic control plan requirements, Section 01 55 26.

B. Coordinate utility locations, Section 01 31 13.

C. Preserve all active utilities.

D. Notify neighborhood at least 48 hours before day and time of operation.

E. Mark existing utilities on redline drawings.

3.2 **PROTECTION**

A. Install Invert Covers, Section 01 71 13.

B. Trees:

1. Avoid or minimize damage to trees and tree roots.
2. Provide certified arborist observation of root cuts larger than four (4) inches diameter. Roots provide anchorage, storage of energy, and absorption and conduction of water and mineral elements. Loss of root connection affects health and stability of tree and safety of people and property. Notify ENGINEER of such root cut.

C. Existing Surfaces:

1. Protect adjacent surfaces including concrete walls, planters, carriage walks, driveway approaches, rock walls, rock gardents concrete steps, sidewalks, and curb cut assemblies. Replace damaged facilities at no additional cost to OWNER.
2. Use rubber cleats or Pavement pads when operating backhoes, outriggers, track equipment, or any other equipment on or crossing paved surfaces.
3. Restore paved surfaces that are damaged by removal operations at no additional cost to the OWNER. Match the existing Pavement surface plus 1 inch.

D. Environment:

1. Control dust, Section 01 57 00.
2. Protect plant and animal habitat. Follow federal, state or local protection requirements.

E. Repair or replace any damage at no additional cost to OWNER.

3.3 REMOVE PORTLAND CEMENT CONCRETE PAVEMENT

A. See APWA Plan 256 requirements.

B. Cutting:

1. DO NOT use machine mounted impact hammers.
2. Make concrete cuts straight, vertical, true, full-depth.
3. Cut along perimeter of panel to be removed. Where edge of existing surface is cracked, broken, or deteriorated, make the cut so the defective surface can be removed.
4. Cut along any edge that is damaged during construction, including cavities underneath caused by construction or concrete removal.

C. Removal:

1. Remove concrete to the nearest expansion joint or vertical saw cut.
2. Remove panels without damaging remaining panels.
3. Remove all bonding inhibitors.

3.4 REMOVE BITUMINOUS CONCRETE PAVEMENT

A. Cutting:

1. Use any method that produces a true, vertical, full-depth cut.
2. When bituminous pavement overlays Portland cement concrete Pavement, DO NOT use machine mounted impact hammers.
3. If an edge of an existing surface is cracked, broken, or deteriorated, make the cut so the defective surface can be removed.
4. Re-cut along any edge that is damaged during construction, and where cavities underneath pavement are caused by construction.

B. Remove Pavement: Remove pavement without damaging remaining.

3.5 REMOVE CONCRETE FLAT WORK

A. Saw cut flat work at weakened plane joints. Saw cut full depth.

B. Where edge of existing surface is cracked, broken, or deteriorated, make the cut so the defective surface can be removed.

C. Saw along any edge that is damaged during construction, including cavities underneath caused by construction.

D. If flat work that is not scheduled for removal is damaged, remove and replace the flat work at no additional cost to OWNER.

3.6 CLEANING

A. Remove all debris and dust. Clean surrounding rails, sidewalks, Driveways, Driveway approaches, landscaping, concrete flat work, and other objects in vicinity of work.

END OF SECTION

DIVISION 03

CONCRETE

SECTION 03 11 00
CONCRETE FORMING

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Formwork for cast-in-place concrete.

B. Openings in formwork for other affected work.

C. Form accessories such as snap ties, bracing, etc.

D. Stripping formwork.

1.2 REFERENCES

A. **ACI Standards**.

347 Recommended Practice for Concrete Formwork.

1.3 DEFINITIONS

A. **Shoring**: The activity to support formwork.

B. **Reshoring**: The activity to reduce the amount of formwork supporting concrete elements. As concrete sets and strength increases, less need for formwork occurs gradually until concrete becomes free standing.

1.4 SUBMITTALS

A. Shop Drawings: Fabrication and erection drawings of forms for specific finished concrete surfaces, as indicated. Show general construction of forms, jointing, special joints or reveals, location and pattern of form tie placement, and other items affecting exposed concrete visibility.

B. Form Release Agent: Where concrete surfaces are scheduled to receive special finishes or applied coverings which may be affected by agent submit manufacturer's instructions for use of agent.

1.5 QUALITY ASSURANCE

A. Designer's Qualifications: Structural design professional who complies with Utah licensing law, has experience in concrete formwork, and is acceptable to the authority having jurisdiction.

B. Design Forms:

1. With sufficient strength to maintain finished tolerances indicated in Section 03 35 00, to support loads, pressures, and allowable stresses as outlined in ACI 347 and for design considerations such as wind loads, allowable stresses, and other applicable requirements of local Laws and Regulations.
2. To permit easy removal.
3. For required finishes.

C. Design, engineering, and construction of formwork is CONTRACTOR's responsibility.

1.6 **JOB CONDITIONS**

A. For reference purposes, establish and maintain sufficient control points and bench marks to check tolerances. Maintain in an undisturbed condition and until final completion and acceptance of Work.

B. Regardless of tolerances specified, allow no portion of Work to extend beyond legal boundaries.

1.7 **FIELD SAMPLES**

A. Prepare field Samples and submit per Section 01 33 00.

B. Construct and erect sample formwork panel for architectural concrete surfaces receiving special treatment or finish as a result of formwork. Formwork to include vertical and horizontal form joints and typical rustication joints when required.

C. Size panel to indicate special treatment or finish required, including form release agent.

D. Remove formwork after casting concrete.

1.8 **ACCEPTANCE**

A. Secure ENGINEER's inspection of form layout for concrete flat work.

PART 2 PRODUCTS

2.1 **FORM MATERIALS**

A. Faced with material which will produce smooth and uniform texture on concrete, unless indicated otherwise.

B. Arrange facing material orderly and symmetrical, keeping number of seams to a minimum.

C. Do not use material with raised grain, patches, or other defects which will impair texture of concrete surface.

2.2 **FORMWORK ACCESSORIES**

A. Form Ties:

1. Use ties constructed so end fasteners can be removed without spalling concrete faces.

2. After end fasteners of ties have been removed, embedded portion of ties are to terminate not less than two (2) times the diameter or thickness of the fasteners from formed faces of concrete, but in no case greater than 3/4 inch.

3. When formed face on concrete is not exposed, form ties may be cut off flush with formed surfaces. Use ties with 3/4 inch diameter cones on both ends or an approved equal for water retaining structures.

B. Premolded Expansion Joint Filler: F1 sheet, Section 32 13 73 unless

indicated elsewhere.

C. Form Release Agent: Colorless material which will not stain concrete, absorb moisture, impair natural bonding or color characteristics of concrete. To prevent contamination, agents used on potable water structures are subject to review by ENGINEER before use.

D. Fillets for Chamfered Corners: Wood strips 1 inch x 1 inch size, maximum length possible.

PART 3 EXECUTION

3.1 INSPECTION

A. Verify lines, levels, and measurements before proceeding with formwork.

3.2 FORM CONSTRUCTION

A. Make forms sufficiently tight to prevent loss of concrete.

B. Unless indicated otherwise, place chamfer strips in corners of forms to produce beveled edges on permanently exposed exterior corners.

C. To maintain specified finish tolerances, camber formwork to compensate for anticipated deflections.

D. Provide positive means of adjustment using wedges, jacks, Shores, and struts to take up all settlement during concrete placing operation.

E. Provide temporary ports in formwork to facilitate cleaning and Inspection. Locate openings at bottom of forms to allow flushing water to drain.

F. At construction joints, overlap forms over hardened concrete at least six (6) inches. Hold forms against hardened concrete to prevent offsets or loss of mortar at construction joint and to maintain true surface.

G. Construct wood forms for wall openings to facilitate loosening, or counteract swelling.

H. Fasten wedges used for final adjustment of forms before concrete placement in position after final check.

I. Anchor formwork to Shores, supporting surfaces or members to prevent upward or lateral movement and deflection of any part of formwork system during concrete placement.

J. Provide runways for moving equipment with struts or legs, supported directly on formwork or structural member without resting on reinforcing.

K. Position expansion joint material and other embedded items accurately and support to prevent displacement.

L. To prevent entry of concrete, fill voids in sleeves, inserts, and anchor slots temporarily with readily removable material.

M. For architectural concrete, limit deflection of facing materials between studs as well as deflection of studs and walers to 0.0025 times span.

N. For underground concrete work, do not use soil walls for forming unless authorized by ENGINEER.

3.3 INSERTS, EMBEDDED PARTS, AND OPENINGS

A. Provide formed openings for elements embedded in or passing through concrete.

B. Coordinate work of other sections for the forming and setting of openings, slots, recesses, chases, sleeves, bolts, anchors, and other inserts.

C. Install accessories per manufacturer's instructions. Ensure items are not disturbed during concrete placement.

3.4 FORM FINISHES

A. Use forms with smooth rubbed, scrubbed, sand floated finishes that meet ACI 347 unless indicated otherwise.

B. For As-cast Finishes:

1. Install form panels in orderly arrangement with joints planned in approved relation to building elements.
2. Where panel joints are recessed or otherwise emphasized, locate form ties within joints, not within panel areas.
3. Where an as-cast finish is required, no grouting will be permitted in the finishing operation.

C. Textured Finishes: As indicated.

3.5 APPLICATION OF FORM RELEASE AGENT

A. Apply form release agent on formwork per manufacturer's instructions. Apply before placing reinforcing steel, anchoring devices, and embedded items.

3.6 FORM REMOVAL

A. Do not pry against face of concrete. Use only wooden wedges.

B. When repair of surface defects or finishing is required at an early age, remove forms as soon as concrete has hardened sufficiently to resist damage from removal operations.

C. Remove top forms on sloping surfaces of concrete as soon as concrete has attained sufficient stiffness to prevent sagging. Perform needed repairs or treatment required on such sloping surfaces at once, followed by specified curing.

D. Loosen wood forms for wall openings as soon as it can be accomplished without damage to concrete.

E. Formwork for columns, walls, sides of beams, and other members not supporting weight of concrete may be removed as soon as concrete has hardened sufficiently to resist damage from removal.

F. Where no Reshoring is planned, leave forms and Shoring used to support weight of concrete in beams, slabs, and other concrete members in place until concrete has attained its specified strength.

G. Where Reshoring is planned, supporting formwork may be removed

when concrete has reached 70 percent of specified strength, provided Reshoring is installed immediately.

H. When Shores and other vertical supports are so arranged that non-load carrying, form-facing material may be removed without loosening or disturbing Shores and supports, facing material may be removed at an earlier age.

3.7 RESHORING

A. When Reshoring is permitted or required, plan operations in advance and obtain approval.

B. During Reshoring do not subject concrete in beam, slab, column, or any other structural member to combined dead and construction loads and live loads in excess of loads permitted for developed concrete strength at time of Reshoring.

C. Place Reshores as soon as practical after stripping operations are complete, but in no case later than end of working day on which stripping occurs.

D. Tighten Reshores to carry required loads without over-stressing.

E. Leave Reshores in place until the concrete being supported has reached its specified strength.

F. For floors supporting Shores under newly placed concrete, level original supporting Shore or Reshore:

1. Reshoring system shall have a capacity to resist anticipated loads in all cases equal to at least 1/2 the capacity of the Shoring system.
2. Unless otherwise specified locate Reshores directly under a Shore.
3. In multistory buildings, extend Reshoring through a sufficient number of stories to distribute the weight of newly placed concrete, forms, and construction live loads in such a manner that design loads of floors and supporting Shores are not exceeded.

G. Design, engineering, and construction of Shoring and Reshoring is the responsibility of the CONTRACTOR.

3.8 REMOVAL STRENGTH

A. When removal of formwork or Reshoring is based on concrete reaching a specified strength, it shall be assumed that concrete has reached this strength when either of the following conditions has been met:

1. When test cylinders, field cured along with the concrete they represent, have reached the specified strength.
2. When concrete has been cured per Section 03 39 00 for the same length of time as the site-cured cylinders that reached specified strength. Determine the length of time the concrete has been cured in the structure by cumulative number of days or fractions thereof, not necessarily consecutive, during which the air temperature is above 50 deg F and concrete has been damp or sealed from evaporation and loss of moisture.

3.9 REUSE OF FORMS

A. Do not reuse forms if there is any evidence of surface wear or defect which would impair quality of concrete surface.

B. Thoroughly clean and properly coat forms before reuse.

3.10 FIELD QUALITY CONTROL

A. Before commencing a pour, verify connections, form alignment, ties, inserts and Shoring are placed and secure.

B. Observe formwork continuously while concrete is being placed to verify that the forms are plumb and there are no deviations from desired elevation, alignment, or camber.

C. If during construction any weakness develops and false-work shows undue settlement or discoloration, stop work, remove affected construction if permanently damaged, and strengthen false-work.

END OF SECTION

SECTION 03 20 00
CONCRETE REINFORCING

PART 1 GENERAL

1.1 **SECTION INCLUDES**

A. Reinforcing steel bars, wire fabric or rod mats for cast-in-place concrete.

B. Support chairs, bolsters, bar supports, and spacers for supporting reinforcement.

1.2 **REFERENCES**

A. **AASHTO Standards**:

M254 Corrosion Resistant Coated Dowel Bars.

B. **ACI Standards**:

301 Structural Concrete for Buildings.

315 Concrete Reinforcement.

C. **ASTM Standards**:

A82 Steel Wire, Plain, for Concrete Reinforcement.

A185 Steel Welded Wire, Fabric, Plain, for Concrete Reinforcement.

A615 Deformed and Plain Billet-Steel Bars for Concrete Reinforcement.

A706 Low-Alloy Steel Deformed Bars for Concrete Reinforcement.

C1116 Fiber-Reinforced Concrete and Shotcrete.

D3963 Epoxy-Coated Reinforcing Steel.

D. **AWS Standards**:

D1.1 Structural Welding Code Steel.

D1.4 Structural Welding Code Reinforcing Steel.

E. **CRSI Standards**:

Manual of Standard Practice.

1.3 **SUBMITTALS**

A. **Manufacturer's Certificate**: Submit mill test certificates of supplied concrete reinforcement, indicating physical and chemical analysis.

B. **Welder's certification**.

C. **Shop Drawings**:

1. Indicate sizes, spacings, locations, and quantities of reinforcing steel, wire fabric, bending and cutting schedules, splicing, stirrup spacing, supporting, and spacing devices.
2. When required, prepare Shop Drawings by an engineer who complies with Utah licensing law and is acceptable to agency having jurisdiction.

1.4 **QUALITY ASSURANCE**

A. Perform concrete reinforcement work per CRSI Manual of Standard Practice.

B. Comply with ACI 301.

C. Welders: Certified to comply with AWS D1.1 or AWS D1.4 as applicable.

1.5 **ACCEPTANCE**

A. Unless specified otherwise, chairs for supporting reinforcement in flat slabs are spaced as follows:

1. Three (3) feet maximum for No. 5 and smaller bars.
2. Five (5) feet maximum for bars larger than No. 5.

B. Dowels are placed on dowel baskets and properly aligned.

C. Epoxy and galvanized coatings are not chipped or cut. Ends of cut bars are epoxy coated or galvanize painted before placement.

D. Minimum covering over reinforcement is as specified.

PART 2 PRODUCTS

2.1 **MATERIALS**

A. Fiber Reinforcement: Glass, ASTM C1116.

B. Reinforcement:

1. Grade 60 ksi deformed steel bars, ASTM A615 and supplementary requirements S1 or ASTM A706 for welding.
2. Welded wire fabric. Plain steel type, ASTM A185 in flat sheets or coiled rolls. Dimensions of the mesh 4”x 4” or as indicated.

C. Stirrups: Steel, ASTM A82.

D. Dowel Bars for Expansion Joints: Grade 60 ksi smooth steel bar, ASTM A615.

1. Galvanized or epoxy coated in roadway Pavements.
2. Provide plastic cap to permit longitudinal movement of dowel bar within concrete section equal to joint width plus 1/4 inch.
3. For load transfer joints, paint bars with 1 coat of paint conforming to AASHTO M254 and coat 1/2 with grease.

E. Coatings for Corrosion Protection:
   1. Epoxy coat, ASTM D3963.
   2. Galvanized, Section 05 05 10.

2.2 ACCESSORY MATERIALS

A. Tie Wire: Minimum 16 gage annealed type or an acceptable patented system.

B. Chairs, Bolsters, Bar Supports, Spacers: Sized and shaped for strength and support of reinforcement during installation and placement of concrete.

2.3 FABRICATION

A. Fabricate reinforcement, ACI 315 providing for concrete cover.

B. Locate reinforcing splices not indicated on Drawings at points of minimum stress. Indicate location of splices on Shop Drawings.

C. Weld reinforcing bars; with AWS D1.4.

PART 3 EXECUTION

3.1 PLACING

A. All reinforcement to be free of loose mill scale, loose or thick rust, dirt, paint, oil or grease.

B. Place all reinforcement in the exact position indicated. With tie wire, tie bars together at all intersections except where spacing is less than 12 inches in each direction, in which case tie alternate intersections.

C. Maintain the distance from vertical forms and between layers of reinforcement by means of prefabricated chairs, ties, hangers, or other approved devices. Placing and fastening of reinforcement in each section of the Work must be approved before concrete is placed.

D. Overlap sheets of metal mesh one square plus six (6) inches to maintain a uniform strength. Securely fasten at the ends, edges, and supports to maintain clearances.

E. Flat Slab Work:
   1. Support reinforcing steel of formed flat slabs with plastic chairs, precast concrete blocks or other non-oxidizing slab bolsters.
   2. Size chairs or bolsters to position the steel in the exact location indicated.
   3. Space chairs and bolsters not more than five (5) feet on centers in each direction.
   4. Coat metal supports in contact with forms to prevent rust.
   5. Tie down deck steel to beams or forms at regular intervals of not more than five (5) feet on centers along the beams or forms to prevent movement of steel during concrete placement.

3.2 SPLICING

A. Furnish all reinforcement in the full lengths indicated unless otherwise permitted. Splicing of bars, except where indicated is not permitted without ENGINEER's knowledge. Stagger splices where possible.

B. Unless indicated otherwise, overlap reinforcing bars a minimum of 30 diameters to make the splice. In lapped splices, place the bars and wire to maintain the minimum distance for clear spacing to the surface of the concrete.

C. Do not use lap splices on bars greater than No. 11 diameter unless approved.

D. Weld reinforcing steel only if indicated or if authorized in writing. Weld in conformance to AWS D1.4.

E. Do not bend reinforcement after embedding in hardened concrete.

F. Do not permit reinforcement or other embedded metal items bonded to the concrete, to extend continuously through any expansion joint, except dowels in floors bonded on only one side of joints.

3.3 PLACING EMBEDDED ITEMS

A. Place all sleeves, inserts, anchors and embedded items before concrete placement. Temporarily fill voids in embedded items to prevent entry of concrete.

B. Give all trades whose work is related to the concrete section (Section 03 30 04) ample notice and opportunity to introduce or furnish embedded items before concrete placement.

END OF SECTION

SECTION 03 30 04
CONCRETE

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Material requirements.

1.2 REFERENCES

A. **ACI Standards**:

211.1 Selecting Proportions for Normal, Heavyweight, and Mass Concrete.

211.2 Selecting Proportions for Structural Lightweight Concrete.

211.3 Standard Practice for Selecting Proportions for No-Slump Concrete.

214 Evaluation of Strength Test Results of Concrete.

301 Specifications for Structural Concrete for Buildings.

305 Hot Weather Concreting.

306 Cold Weather Concreting.

318 Building Code Requirements for Reinforced Concrete.

B. **ASTM Standards**:

C33 Concrete Aggregates.

C39 Compressive Strength of Cylindrical Concrete Specimens.

C88 Soundness of Aggregates by Use of Sodium Sulfate or Magnesium Sulfate.

C94 Ready-Mixed Concrete.

C117 Material Finer than 75µ (No. 200) Sieve in Mineral Aggregates by Washing.

C123 Lightweight Particles in Aggregate.

C138 Unit Weight, Yield, and Air Content (Gravimetric) of Concrete.

C142 Clay lumps and Friable Particles in Aggregates.

C143 Slump of Hydraulic-Cement Concrete.

C150 Portland Cement.

C172 Sampling Freshly Mixed Concrete.

C227 Potential Reactivity of Cement-Aggregate Combinations (Mortar Bar Method).

C231 Air Content of Freshly Mixed Concrete by the Pressure Method.

C260 Air-Entraining Admixtures for Concrete.

C289 Potential Reactivity of Aggregates (Chemical Method).

C295 Petrographic Examination of Aggregates for Concrete.

C441 Effectiveness of Mineral Admixtures or Ground Blast-Furnace Slag in Preventing Excessive Expansion of Concrete Due to The Alkali-Silica Reaction.

C494 Chemical Admixtures for Concrete.

C535 Resistance to Degradation of Large-Size Coarse Aggregate by Abrasion and Impact in the Los Angeles Machine.

C595 Blended Hydraulic Cements.

C618 Fly Ash and Raw or Calcined Natural Pozzolan for Use as a Mineral Admixture in Portland Cement Concrete.

C1064 Temperature of Freshly Mixed Portland Cement Concrete.

C1077 Laboratories Testing Concrete and Concrete Aggregates for Use in Construction and Criteria for Laboratory Evaluation.

C1116 Fiber-Reinforced Concrete and Shot Crete.

C1157 Blended Hydraulic Cement.

C1240 Use of Silica Fume as a Mineral Admixture in Hydraulic Cement Concrete, Mortar, and Grout.

C1260 Potential Alkali Reactivity of Aggregates (Mortar-Bar Method).

C1293 Concrete Aggregates by Determination of Length Change of Concrete Due to Alkali-Silica Reaction.

C1567 Determining the Potential Alkali-Silica Reactivity of Combinations of Cementitious Materials and Aggregate (Accelerated Mortar-Bar Method).

C1602 Mixing Water Used in The Production of Hydraulic Cement Concrete.

STP 15-C Manual on Quality Control of Materials.

1.3 **SUBMITTALS**

A. **Quality Assurance**:

1. Independent Laboratory: Submit names, certification levels, and years of experience of testing agency's field technicians that are assigned to the Work. Verify laboratory complies with ASTM and ACI standards.
2. Mixing Equipment: Submit certification of plant equipment.

B. **Mix Design**: Allow ENGINEER 10 days to evaluate the submittal. Provide the following information.

1. Date of mix design. If older than 365 days from date of submission recertify mix design.
2. Physical properties of the aggregate (this section article 2.3). Test results shall not be older 455 days from the date of submission. The

information is for suitability of source and not for project control. A new report may be required if aggregate source is changed.

3. Identify whether mix is for hot, cold, or normal weather placement.
4. Cement source, type and chemical composition.
5. Aggregate soundness and potential reactivity.
6. Average Strength (f_{cr}), per quality control chart.
7. Allowable range of slump and air content.
8. Water cement ratio.
9. Proportions of materials in the mix.
10. Unit weight.
11. Analysis of water if water is not potable.
12. Mortar bar or prism test results if a pozzolan is included in the mix.
13. Technical data sheets for additives to be used at the plant and at the job site. Certify additives are compatible with each other.

C. **Pre-approved Mix Design**: Submit name and address of Supplier and Suppliers mix design number if available.

D. **Before Changing Mix Design**: Submit a new design and allow ENGINEER 10 days to evaluate the changes.

1.4 **QUALITY ASSURANCE**

A. **General**:

1. Use a laboratory that follows and complies with ASTM C1077.
2. Reject concrete that does not meet requirements of this section.
3. If requested, submit a quality control and testing report describing source and field quality assurance activities performed by CONTRACTOR and Suppliers.

B. **At Source**:

1. Do not change material sources, type of cement, air-entraining agent, water reducing agent, other admixtures except as allowed by mix design.
2. Store bagged and bulk cement in weatherproof enclosures. Exclude moisture and contaminants.
3. Prevent segregation and contamination of aggregate stockpiles.
4. Avoid contamination, evaporation, or damage to admixtures. Protect liquid admixtures from freezing.

C. **At Site**: Use of admixtures will not relax hot or cold weather placement requirements.

1.5 ACCEPTANCE

A. **Materials**:

1. Aggregate Source:
   a. Verify suitability of aggregate source.
   b. Verify aggregate gradation.
   c. Verify percent of combined aggregate passing No. 200 sieve.
2. At the Site:
   a. Verify mix identification, batch time, slump, air content, and temperature.
   b. Verify drum rotation is less than 300 revolutions.
3. At the Laboratory: Verify strength in 28 days.

B. **Defective Material**: Popouts, scaling, etc.

1. Price adjustment, Section 01 29 00 and Section 03 30 10.
2. Dispute resolution, Section 01 35 10.

PART 2 PRODUCTS

2.1 CEMENT

A. **General**:

1. Do not use air entraining cement except for hand mixed applications.
2. Do not use cement containing lumps or is partially set.
3. Do not mix cement originating from different sources.

B. **Standard Set Cement**:

1. Type II cement per tables 1 and 3 in ASTM C150, or Type V when necessary, or
2. Low-alkali cement per Table 2 in ASTM C150.

C. **Blended Hydraulic Cement**: The following are cement equivalencies when substituting blended cement for a Portland cement.

Table 1 – Cement Equivalencies

Portland Cement ASTM C150	Blended Cement ASTM C595	Blended Cement ASTM C1157
Type I	IP	GU
Type II	IP (MS)	MS
Type III	--	HE
Type IV	--	--
Type V	--	HS

D. **Rapid Set Cement**: As above and as follows:

1. Initial set time: 15 minutes minimum.

2. Color: Acceptable to the ENGINEER.

2.2 WATER

A. Clean, non-staining, non-detrimental per ASTM C1602.

B. Screen out extraneous material.

C. Do not use alkali soil water.

2.3 AGGREGATES

A. Gravel, crushed gravel, crushed stone, crushed concrete, slag, sand or combination with the following physical properties.

Table 2 – Physical Properties

		Standard	Min	Max
Coarse Aggregate				
Wear (hardness or toughness), percent (a)		(a)	--	50
Soundness (5 cycles), percent	Na_2SO_4	C88	--	12
	Mg_2SO_4	C88	--	18
Coal and lignite (SG = 2.4 min.), percent (b)		C123	0.5	1.0
Clay lumps, friable particles, chert, percent		C142	--	7
Material finer than 200 sieve, percent		C117	--	1.0
Fine Aggregate				
Soundness (5 cycles), percent	Na_2SO_4	C88	--	10
	Mg_2SO_4	C88	--	15
Fineness modulus		C33	2.3	3.1
Coal and lignite (SG = 2.4 min.), percent (b)		C123	0.5	1.0
Clay lumps, friable particles, chert, percent		C142	--	3.0
Aggregate blend (meets one of the following)				
1. Average prism length change in 12 months, percent (c)		C1293	--	0.04
2. Average mortar bar length change in 16 days, percent (c)		C1260	--	0.10
3. Petrography limits, percent				
Quartz.....(d)		C295	--	5.0
Chert or chalcedony			--	3.0
Tridymite or cristobalite.....			--	1.0
Opal.....			--	0.5
Natural glass in volcanic rock			--	3
4. Historical data acceptable to ENGINEER				

NOTES

(a) Wear retained on No. 8 sieve. For aggregate less than 1 1/2" use ASTM C131. For larger aggregates use ASTM C535.

(b) Organic impurities producing a dark color concrete may cause rejection.

(c) Prism length change and mortar bar length change based upon unmodified ASTM tests.

(d) Quartz must NOT be optically strained, micro-fractured, or microcrystalline in nature.

2.4 ADDITIVES

A. Calcium Chloride: Not allowed in reinforced concrete.

B. Air Entrainment: ASTM C260. For extrusion enhancement use non-vinsal resin.

C. Set Enhancement and Water Reducing Agents: ASTM C494.

1. Type A: Water reducing.
2. Type B: Set retarding.
3. Type C: Set accelerating.
4. Type D: Water reducing and set retarding.
5. Type E: Water reducing and set accelerating.
6. Type F: High range water reducing (super plasticizer). *
7. Type G: High range water reducing and set retarding. *

* Keep the relative durability factor of water reducing additives not less than 90 and the chlorides content (as Cl^-) not exceeding 1 percent by weight of the admixtures.

D. Pozzolan:

1. Natural or fly ash per ASTM C618.
2. Silica fume per ASTM C1240.

E. Special Admixtures: Allowed if mix design submittal is accepted:

1. Lithium nitrate based solution for control of reactive aggregates.
2. Calcium nitrite based solution for corrosion protection of reinforced structures subject to chloride-induced corrosion.
3. Shrinkage reducer for controlling drying shrinkage in concrete.
4. Viscosity modifier for enhancement of self consolidating concrete or for workability.

2.5 MIX DESIGN

A. **Class**: Unless specified elsewhere, as follows.

1. Above Ground: 5000 minimum.
2. At Ground Level: 4000 minimum.
3. Underground: 4000 minimum.

B. **Selection of Cement**: ASTM C150 or C1157.

1. For sulfate resistance, use Type V Portland cement, or Type II with Class F fly ash. Class F fly ash may be used as an addition to Type V Portland cement.
2. Do not use fly ash with Type IP(MS) or Type III Portland cement.

C. **Selection of Aggregates**:

1. Maximum Particle Size:
   a. 1/5 of narrowest dimension between forms.
   b. 1/3 of depth of slab.

c. 3/4 of minimum clear spacing between reinforcing bars.

2. Gradation: ASTM C33.

a. Coarse Aggregate: Choose from the following grades. Gradations are based upon percent of material passing sieve by weight.

Table 3 – Coarse Aggregate Gradation				
Sieve	**Grade**			
	357 (2”)	**467 (1.5”)**	**57 (1”)**	**67 (3/4”)**
2-1/2”	100	--	--	--
2 Inch	95 - 100	100	--	--
1-1/2”	--	95 – 100	100	--
1”	35 – 20	--	95 – 100	100
3/4"	--	35 – 70	--	90 – 100
1/2"	10 – 30	--	25- 60	--
3/8”	--	10 – 30	--	20 – 55
No. 4	0 – 5	0 – 5	0 – 10	0 – 10

b. Fine Aggregate:

Table 4 – Fine Aggregate Gradation	
Sieve	**Percent Passing by Weight**
3/8”	100
No. 4	95 to 100
No. 16	45 to 80
No. 50	10 to 30
No. 100	2 to 10

c. Silts and Clays: The amount of material smaller than the No. 200 sieve in any combined gradation sample is limited to the following percentages by weight of the combined sample:

1) 1.75 percent maximum for concrete subject to abrasion.

2) 3.0 percent maximum for all other concrete.

D. **Selection of Pozzolan**:

1. General: If a blended aggregate passes an unmodified ASTM C1293 test, use of a pozzolan is CONTRACTOR’s choice. If aggregate does not pass ASTM C1293, select a pozzolan (or blended cement, or both) and determine the effective dosage to meet one of the following tests:

a. ASTM C1567. The expansion of a cement-pozzolan-aggregate job-mix mortar bar is less than or equal to 0.10 percent at 16 days. Do not use this test if a lithium admixture is used in the job-mix.

b. ASTM C441. The expansion of a test mixture at 56 days is less than or equal to a control mixture prepared with cement with equivalent alkalis between 0.5 and 0.6 percent.

2. Fly Ash (Class F): Allowed as a cement replacement under the following conditions:
   a. Before replacement is made, use the minimum cement content in the design formula to establish the water/cement ratio.
   b. Replace up to 20 percent of the cement by weight on a one (1) part fly ash to one (1) part cement basis.
   c. Submit to ENGINEER a quality history of the fly ash identifying a minimum of 20 of the most current ASTM C618 analysis.
3. Natural Pozzolan (Class N): Allowed as a cement replacement if the 14 day expansion test (ASTM C1567) with job aggregates, job cement and natural pozzolan does not exceed the 14 day expansion test of job aggregates, job cement and Class F fly ash.
4. Silica Fume: Allowed as a cement replacement if replacement of hydraulic cement on a 1 part silica fume to 1 part cement does not exceed 10 percent, and water/cement ratio is established before cement is replaced with silica fume.

E. **Selection of Mix Properties**: Select and proportion the mix to produce appropriate strength, durability and workability. Use ACI 211.1, 211.2, or 211.3, and meet the following properties and limitations:

Table 5 – Mix Properties and Limitations

Properties		Standard	Class 2000	Class 3000	Class 4000	Class 5000
Compressive Strength (f_c') at 28 days, psi, minimum		C39	2000	3000	4000	5000
Compressive Strength at 7 days, psi, (for reference only)		C39	1340	2010	2680	3350
Average Strength, psi (f_{cr})		214	(a)	(a)	(a)	(a)
Cement content, bags, minimum (b)		--	4.5	5.5	6.5	7.5
Water-cement ratio (by weight), maximum (c)		318	(d)	(d)	0.44	
Entrained air, percent (based upon aggregate size) (e)	2” 1-1/2” 1” 3/4"	C231	3.0 to 6.0 ” ” ”	4.5 to 7.5 ” ” ”	4.0 to 7.0 4.5 to 7.5 5.0 to 7.5 5.0 to 7.5	
Slump		C143	(d)	(d)	(d)	(d)

NOTES

(a) The amount by which average strength (f_{cr}) exceeds compressive strength (f_c') is based upon statistical assurance that no more than 1 test in 100 tests will fall below compressive strength (f_c').

(b) Unless allowed otherwise by ENGINEER.

(c) Before pozzolan substitution.

(d) Specific to exposure conditions and finishing need.

(e) Comply with ACI 211.1 if air content is changed.

(f) 1 bag of cement = 94 pounds.

1. Cold Weather: ACI 306. Unless allowed otherwise by ENGINEER, increase cement content in the mix design by 1 class between **October 1 and March 1,** i.e. Class 3000 becomes Class 4000, Class 4000 becomes Class 5000, etc.
2. Hot Weather: ACI 305. Reduce temperature of mix ingredients or use an admixture appropriate to job conditions when air temperature is over 75 deg F.
3. Concrete Deposited Under Water: Increase cement content one (1) class for concrete placed above water or use viscosity modifying admixture.

F. **Selection of Fiber Reinforcement**: The basis for determining material proportions of fiber-reinforced concrete is the Supplier's responsibility per ASTM C1116 subject to mix property requirements of this Section. Unless specified otherwise provide synthetic fibers.

2.6 SOURCE QUALITY CONTROL

A. **General**: Collect Samples randomly. Do not change source quality control sampling point.

B. **Aggregate**:

1. Soundness, ASTM C88.
2. Alkali-silica reactivity, ASTM C289, C1567, C1260, C227 and C1293.
3. Petrographically examine fine and coarse aggregate sources once every three (3) years, ASTM C295.

C. **Concrete Mix**: Obtain samples per ASTM C172 and run the following tests:

1. Compressive strength, ASTM C39.
2. Unit weight, ASTM C138.
3. Slump, ASTM C143.
4. Air, ASTM C231.
5. Temperature, ASTM C1064.

D. **Concrete Quality Charts**: Comply with ACI 214 and ACI 301. Plot new results and identify trends on quality control charts that comply in form to ASTM STP 15-C. Show the Specified Strength (f_c'), the required Average Strength (f_{cr}), and the compressive strength versus date of Sample.

E. **Equipment**: Certify at least every two (2) years through the services of a design professional licensed in the State of Utah, that plant equipment complies with requirements of the National Ready Mixed Concrete Association and ASTM C94.

1. Transit Trucks: Equip transit trucks with plates indicating total volume, agitating volume and mix volume.
2. Weights and Measures: Comply with regulatory requirements of State of Utah.

PART 3 EXECUTION

3.1 INSTALLATION

A. Placement, Section 03 30 10.

3.2 FIELD QUALITY CONTROL

A. Truck Mixed Concrete (Dry Batch): ASTM C94.

1. Truck Mixer: Fill drum no more than 63 percent of the gross drum volume and no less than two (2) cubic yards. Use drum manufacturer's recommended mixing speed (between 12 – 18 rpm).
2. Truck Agitator: Do not fill drum greater than 80 percent of the gross drum volume. Use drum manufacturer's recommended agitating speed (between 2 – 6 rpm).

B. Mixing Plant: ASTM C94.

1. Use option C and requirements in this Section for preparing ready-mixed concrete.
2. Use scales certified by the State of Utah. Do not use volume measurement except for water and liquid admixtures.
3. Mixing time must exceed 80 seconds after adding air entrainment admixture.

C. Hand Mixing:

1. Do not hand mix batches larger than 0.5 cubic yard.
2. Hand mix only on a watertight platform.
3. Ensure all stones are thoroughly covered with mortar and mixture is of uniform color and consistency before adding water.

END OF SECTION

SECTION 03 30 05
CONCRETE TESTING

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Concrete sampling and testing requirements.

1.2 REFERENCES

A. **ACI Standards**:

318 Building Code Requirements for Reinforced Concrete.

B. **ASTM Standards**:

C31 Making and Curing Concrete Test Specimens in the Field.

C39 Compressive Strength of Cylindrical Concrete Specimens.

C42 Obtaining and Testing Drilled Cores and Sawed Beams of Concrete.

C78 Standard Test Method for Flexural Strength of Concrete (Using Simple Beam with Third-Point Loading).

C136 Standard Method for Sieve Analysis of Fine and Coarse Aggregates.

C138 Unit Weight, Yield, and Air Content (Gravimetric) of Concrete.

C143 Slump of Portland Cement Concrete.

C172 Sampling Freshly Mixed Concrete.

C173 Air Content of Freshly Mixed Concrete by Volumetric Method.

C231 Air Content of Freshly Mixed Concrete by the Pressure Method.

C567 Unit Weight of Structural Lightweight Concrete.

C1064 Temperature of Freshly Mixed Portland Cement Concrete.

C1077 Laboratories Testing Concrete and Concrete Aggregates for Use in Construction and Criteria for Laboratory Evaluation.

1.3 SUBMITTALS

A. **Concrete Supplier**: If requested, submit reports and material certificates verifying concrete quality control.

B. **Laboratory**: Promptly submit test data results for seven (7) and 28 day breaks to Supplier, CONTRACTOR and ENGINEER**.**

1.4 QUALITY ASSURANCE

A. Provide an ASTM C1077 compliant and ACI certified laboratory.

B. Provide level I ACI certified field sampling technicians.

1.5 SITE CONDITIONS

A. **Assist ENGINEER**: Furnish labor to assist ENGINEER in obtaining and handling acceptance Samples at site or sources.

B. **Store and Cure Test Specimens**: Safely store and cure concrete test specimens and acceptance test specimens for first 24 hours:

1. Follow ASTM C31 in making and curing cylinders or beams at site. Do not move the cylinders or beams for the initial 16 hour cure period. Provide initial cure temperature as follows:

   a. 60 to 80 deg F for Class 4,000 or less.

   b. 68 to 78 deg F for Class 5,000 or greater.

2. Equip storage device with an automatic 24 hour temperature recorder with an accuracy of plus or minus two (2) deg F

3. Use water containing hydrated lime if water is to be in contact with cylinders or beams.

4. Ensure the device(s) can accommodate the required number of test cylinders or beams. Lack of capacity will cause the placement of concrete to cease.

5. Have the storage devices available at the point of placement at least 24 hours before placement.

6. A 24 hour test run may be required.

1.6 ACCEPTANCE

A. At the Laboratory:

1. Compressive strength, ASTM C31.

2. Flexure strength, ASTM C78.

B. At the Site:

1. Acceptance: Reject non-complying batches until two (2) consecutive batches are compliant then proceed in random batch testing for acceptance.

2. Sampling Protocol: ASTM C172. Unless indicated otherwise follow Table 1 sampling frequency requirements. Collect sample at discharge chute before placement, or at pumper hose after priming grout has been wasted.

Table 1 – Sampling Frequency				
Rate of Placement (Cubic Yard / Day)	**Temperature**	**Air**	**Slump**	**Strength**
0 - 8	1	1	1	Determined by ENGINEER
0 - 50	1	1	1	1
Each additional 50 cu. yd. or fraction thereof	1	1	1	1

3. Testing Protocol:
   a. Temperature, ASTM C1064.
   b. Air content, ASTM C231 or ASTM C173 if lightweight aggregate is used.
   c. Slump, ASTM C143.

PART 2 PRODUCTS

Not Used

PART 3 EXECUTION

3.1 PRECAST PRODUCTS

A. Obtain composite Samples from different portions of the batch.
B. Make and cure concrete test specimens for acceptance, ASTM C31.
C. Cure all precast products with water vapor or water.
D. Do not damage precast products by stripping forms or handling before the concrete reaches its specified strength.

3.2 CAST-IN-PLACE PRODUCTS

A. Obtaining Samples:
   1. Batch samples, ASTM C172.
   2. Core samples, ASTM C42.
B. Identify location of tests on test reports.
C. Compressive strength, ASTM C39:
   1. Mold four (4) test specimens, ASTM C31.
   2. For strength test perform slump, air, unit weight, and temperature test.
   3. Break 1 cylinder at seven (7) days and three (3) cylinders at 28 days. The average strength of three (3) cylinder breaks shall be considered the test result.

4. If any one cylinder in a 28 days test shows definite evidence of improper sampling, molding, handling, curing, or testing, discard the cylinder. The average strength of the remaining cylinders shall be considered the test result.

D. Tensile (flexural) strength, ASTM C78:

1. Mold four (4) test specimens, ASTM C31.
2. For strength test perform slump, air, unit weight, and temperature test.
3. Break 1 beam at seven (7) days and three (3) beams at 28 days. The average strength of the three (3) beam breaks shall be considered the test result.
4. If any one beam in a 28 days test shows definite evidence of improper sampling, molding, handling, curing, or testing, discard the beam. The average strength of the remaining beams shall be considered the test result.

E. Aggregate, ASTM C136 for fine and coarse aggregate.

F. Slump test, ASTM C143.

G. Air Test:

1. Normal weight concrete, ASTM C231.
2. Light weight concrete, ASTM C173.

H. Unit Weight:

1. Normal weight concrete, ASTM C138.
2. Light weight concrete, ASTM C567.

I. When requested, test in-place concrete by impact hammer, sonoscope, or other non-destructive device:

1. To determine relative strengths in various locations in Work.
2. To aid in evaluating concrete strength.
3. To select areas to be cored.
4. To verify quality control in the absence of control testing.

3.3 RETESTING DEFECTIVE CONCRETE STRENGTH

A. If CONTRACTOR desires to do a retest, a request to ENGINEER for retesting must be made within 35 days from time of concrete placement. No coring or retesting shall be done after 40 days have elapsed from the time of placement:

1. Choose three (3) random test locations and verify choice with ENGINEER. Obtain retest samples per ASTM C42 and test compressive strength per ASTM C39 or flexure strength per ASTM C78.
2. Establish a chain of custody for all test samples.
3. If concrete placed in the Work will be dry under service condition, air dry cores for seven (7) days before tests. Unless otherwise specified, use air temperature 60 to 80 deg F and relative humidity less than 60 percent.

4. If concrete placed in the Work will be more than superficially wet under service conditions, test cores after moisture conditioning (liquid or vapor water cure).
5. If more than 1 core shows evidence of having been damaged before testing provide replacement cores, otherwise evaluation will be done on two (2) or more core samples.
6. Evaluate cores in accordance with ACI 318 requirements.
7. If core tests are inconclusive, or impractical to obtain, or if structural analysis does not confirm the safety of the Work, load test may be used and evaluated in accordance with ACI 318 requirements.

B. Coat sides of core hole with concrete epoxy resin adhesive. Fill core holes with non-shrink concrete mortar. Match color and texture of surrounding concrete.

C. Within 40 days from time of placement publish the chain of custody record and the results of retesting.

END OF SECTION

SECTION 03 30 10
CONCRETE PLACEMENT

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Concrete placement for slabs on grade, slabs on fill, structural building frame, and other concrete components.

1.2 REFERENCES

A. **ACI Standards**:

301 Structural Concrete for Buildings.

305 Hot Weather Concreting.

306 Cold Weather Concreting.

309 Consolidation of Concrete.

B. **ASTM Standards**:

C881 Epoxy-Resin-Base Bonding Systems for Concrete.

C1059 Latex Agents for Bonding Fresh to Hardened Concrete.

1.3 SUBMITTALS

A. **Batch Delivery Ticket**: For each batch delivered to site, identify:

1. Date and Project description.
2. Producer and plant.
3. Name of contractor.
4. Serial number of ticket.
5. Mix identification number or code.
6. Truck number and time dispatched.
7. Volume of concrete.
8. Type and amount of cement.
9. Total water and water/cement ratio.
10. Water added for receiver of concrete and receiver's initials.
11. Admixture types.
12. Separate weights of fine and coarse aggregate.
13. Statement of whether batch is pre-mixed at plant or mixed in transit.

B. **Record of Placed Concrete**: Identify date of record, location of pour, quantity, air temperature, and CONTRACTOR's quality control test Samples taken.

C. **Bonding Compound**: Identify product name, type, and chemical analysis.

1.4 **QUALITY ASSURANCE**

A. Provide ACI certified finishers.

B. Remove and replace any placed concrete suffering hot or cold weather damage.

C. For control testing follow Section 03 30 05 requirements.

1.5 **ACCEPTANCE**

A General:

1. Price adjustment, Section 01 29 00. CONTRACTOR may request ENGINEER determine appropriate Modifications or payment adjustments to pay for Defective work.

2. Retesting by CONTRACTOR, Section 01 35 10 and Section 03 30 05.

B. Concrete work that fails to meet any of the following requirements will be considered defective. Replace Defective Work at no additional cost to OWNER:

1. Placement:

a. Reinforcing steel size, quantity, strength, position, damage, or arrangement is not as specified or does not comply with code.

b. Formwork differs from required dimensions or location in such a manner as to reduce concrete's strength or load carrying capacity or physical esthetics.

c. Workmanship likely to result in deficient strength.

2. Finishing:

a. Concrete exposed to view has defects that adversely affect appearance.

b. Slab tolerances of Section 03 35 00 are not met.

3. Protection:

a. Method of curing is not as specified.

b. Inadequate protection of concrete during early stages of hardening and strength development from:

1) temperature extremes.

2) rapid moisture loss.

c. Mechanical injury, construction fires, accidents, or premature removal of formwork likely to result in deficient strength development.

PART 2 PRODUCTS

2.1 MATERIALS

A. Concrete: Section 03 30 04. Class as indicated:

1. For roadway cuts, Section 33 05 25.

B. Bonding Compound: ASTM C1059. Either polyvinyl acetate base or acrylic base latex:

1. Use type I in areas not subject to high humidity or immersion in water with minimum bond strength of 400 psi.
2. Use type II in areas subject to high humidity or immersion in water with minimum bond strength of 1250 psi.

C. Vapor Retarder: 10 mil thick clear polyethylene sheet. Type recommended for below grade application.

D. Forms: Section 03 11 00.

E. Reinforcement: Section 03 20 00.

F. Coverings and Curing Compound: Section 03 39 00.

G. Shrinkage Compensating Grouts: Section 03 61 00.

H. Epoxy Adhesive: Section 03 61 00.

PART 3 EXECUTION

3.1 EXAMINATION

A. Verify items to be cast into concrete are accurately placed and held securely.

B. Verify slump, air content range, mix identity, and batch time on delivery ticket matches mix design.

C. Verify slab steel mats are supported by steel chairs, precast concrete blocks, or other slab bolsters. Do not pour if absent.

3.2 PREPARATION

A. Implement traffic control plan requirements, Section 01 55 26.

B. Notify ENGINEER no later than 24 hours before commencement of concrete placement.

C. Do not allow construction loads to exceed structural capacity.

D. Clean previously placed concrete. Apply bonding compound per manufacturer's instructions.

E. At locations where new concrete is dowelled to existing work, drill, remove dust, insert and pack steel dowels with shrink compensating grout, and expansion caps where required.

3.3 DELIVERY

A. Concrete Temperature: Keep mixed concrete temperature before placement between 60 deg F. and 90 deg F.

B. Slump and Air Content: Keep within allowable ranges.

C. Transport Time:

Air Temperature	Time After Initial Batching
Less than 90 deg F	1–1/2 hours
Greater than 90 deg F	1–hour (without retarder)
Greater than 90 deg F	1–1/2 hours (with retarder)

To increase time past 1-1/2 hours, a hydration stabilizer that is acceptable to Supplier may be used.

D. Tempering:

1. Water may be added if all following conditions are met:
   a. The mix design water/cement ratio is not exceeded.
   b. The delivery ticket allows for addition of water based upon water/cement ratio.
   c. The amount of water added is accurately measured to within 1 gallon of the design addition.
   d. Water addition is followed by three (3) minutes of mixing at mixing speed before discharge.
   e. Supplier and CONTRACTOR mutually agree on who is authorized to add water.
2. **Do not add water after 1 cubic yard of concrete has discharged from the delivery vehicle.**

E. Super-plasticizer: Comply with manufacturer's requirements. If none, then as follows:

1. If added at site, add agent using injection equipment capable of rapidly and uniformly distributing admixture to concrete. Before discharge, mix for a minimum of five (5) minutes at a drum rate not less than 12 rpm or more than 15 rpm.
2. If added at plant, do not deliver to site unless batch delivery ticket displays water/cement ratio before super-plasticizer addition.

3.4 CONCRETE PLACEMENT

A. In General: ACI 301.

1. Do not disturb reinforcement, inserts, embedded parts, and formed joints.
2. Do not break or interrupt successive pours such that cold joints occur.
3. Honeycomb or embedded debris in concrete is not acceptable.

B. Hot Weather Placement: ACI 305. If the rate of evaporation approaches 0.2 lb./ft^2/hr. precautions against plastic shrinkage cracking are necessary. (i.e. dampening Subgrade and forms; placing concrete at the

lowest possible temperature; erecting windbreaks and sunshades; fog sprays; use of evaporation retardants; or rescheduling time of placement).

C. Cold Weather Placement: ACI 306. Accelerating admixture may be used in concrete work placed at ambient temperatures below 50 deg F Use of admixtures will not relax cold weather placement, curing, or protection requirements. . If air temperature is forecasted to fall below 32 deg F. within 14 days of placement, proceed as follows:

1. Provide cold weather protection (cover, insulation, heat, etc.).
2. Do not use chemical “anti-freeze” additives in the concrete. (NOTE: this does not apply to normal accelerators.)
3. Do not proceed with the placement of concrete until the temperature of all contact surfaces is 35 degrees F and ambient temperature is ascending.
4. Protect the concrete from freezing until a compressive strength of at least 90 percent of design strength has been achieved, determined by either:
   a. Maturity meter. Refer to AASHTO T 325, or.
   b. Field cured cylinders.
5. Adequately vent combustion-type heaters that produce carbon monoxide.
6. When applying external heat, maintain moist conditions to avoid excessive moisture loss from concrete.
7. When removing heat, limit drop in temperature of concrete surfaces to 20 degrees F during any 12 hour period until the surface temperature of the concrete reaches that of the atmosphere.

D. Concrete Temperature: Keep mixed concrete temperature at time of placement between 60 deg F and 90 deg F

E. Do not disturb reinforcement, inserts, embedded parts, and formed joints.

F. Do not break or interrupt successive pours such that cold joints occur.

G. Honeycomb or embedded debris in concrete is not acceptable.

3.5 JOINTS AND JOINT SEALING

A. Steel edging and jointing tools are acceptable. Preferred are magnesium, aluminum or wood tools

B. Pavement joint sealing, Section 32 13 73.

3.6 CONSOLIDATION

A. Keep spare vibrator available during concrete placement operations.

B. Follow ACI 309 requirements.

3.7 CURING

A. Section 03 39 00. Use a membrane forming compound unless specified otherwise.

3.8 FINISHING

A. Section 03 35 00 and as follows.

Table 1 – Finishes	
Type of work	**Finish**
Sidewalks, garage floors, ramps, exterior concrete Pavement	Broom or belt
Exterior platforms, steps, and landings, exterior and interior pedestrian ramps, not covered by other finish materials	Non-slip
Surfaces intended to receive bonded applied cementitious applications	Scratched
Surfaces intended to receive roofing, except future floors, waterproofing membranes, and roof surfaces that are future floors or sand bed terrazzo	Floated
Floors and roof surfaces that are floors intended as walking surfaces or to receive floor coverings	Troweled
Unpainted concrete surfaces not exposed to public view	Rough as-cast form finish
Unpainted concrete surfaces exposed to public view	Smooth as-cast form finish
Concrete surfaces to receive paint or plaster	Grout cleaned finish

3.9 PROTECTION AND REPAIR

A. Protection, Section 01 66 00:

1. Immediately after placement, protect concrete from premature drying, excessively hot or cold temperatures, graffiti, and mechanical injury.
2. Maintain concrete with minimal moisture loss at relatively constant temperature for period necessary for hydration of cement and hardening of concrete.

B. Repair:

1. Modify or replace concrete not conforming to required levels, lines, details, and elevations.
2. Structural analysis and additional testing may be required at no additional cost to OWNER when the strength of a structure is considered potentially deficient.
3. To patch imperfections refer to Section 03 35 00 requirements.
4. Remove graffiti and mechanical injury.

END OF SECTION

SECTION 03 35 00
CONCRETE FINISHING

PART 1 GENERAL

1.1 **SECTION INCLUDES**

A. Finishing interior and exterior concrete surfaces.

1.2 **REFERENCES**

A. **ACI Standards**:

303 Guide to Cast-in-Place Architectural Concrete Practice.

1.3 **SUBMITTALS**

A. Name, type, chemical analysis and manufacturer's recommended rate of application for liquid chemical hardener.

1.4 **PROJECT CONDITIONS**

A. Protect adjacent materials and finishes from dust, dirt and other surface or physical damage during finishing operations. Provide protection as required and remove from site at completion of Work.

PART 2 PRODUCTS

2.1 **MATERIALS**

A. Masonry Mortar and Grout: Section 04 05 16.

B. Dry Shake: Blend of metallic or mineral aggregate with Portland cement concrete in proportions recommended by manufacture.

C. Proprietary Materials: If permitted or required, proprietary compounds may be used in lieu of or in addition to foregoing blended materials. Use such compounds per manufacturer's recommendations.

D. Liquid-Chemical Hardener: Colorless, aqueous solution containing a blend of magnesium fluosilicate, zinc fluosilicate and a wetting agent. Mixture contains not less than two (2) pounds fluosilicate per gallon and does not interfere with adhesives and bonding.

PART 3 EXECUTION

3.1 **PREPARATION**

A. Examine areas and conditions under which work of this section will be performed.

B. Correct conditions detrimental to timely and proper finishing.

C. Do not proceed until unsatisfactory conditions are corrected.

3.2 FINISHING HORIZONTAL SLABS

A. **Do not apply water (i.e. sprinkle) to any surface of concrete when finishing slabs.**

B. Edges and Joints: Tools may be made out of steel. Preferred is wood, aluminum or magnesium.

C. Tolerances:

1. Class A: 1 in 1000.
2. Class B: 1 in 500.
3. Class C: 1 in 250.

D. Float Finish: After concrete has been placed, consolidated, struck-off, and leveled, do not work further until ready for floating:

1. Begin floating when water sheen has disappeared and surface has sufficient stiffness.
2. During or after first floating, check planeness of entire surface with a 10 feet long straightedge applied at two (2) or more different angles.
3. Cut down high spots and fill low spots to the required tolerance.
4. Refloat slab immediately to a uniform sandy texture.

E. Trowel Finish:

1. Do not use steel trowel or a power trowel on exterior concrete or on concrete that contains more than three (3) percent air.
2. First troweling shall produce smooth surface relatively free of defects but which may still show some trowel marks.
3. Second troweling after surface has stiffened shall make finished surface essentially free of trowel marks, uniform in texture and appearance.
4. On surfaces intended to support floor coverings, grind off defects that would show through floor covering.

F. Broom or Belt Finish: Sweep surface with brushes, rakes, tines or burlap belt before final set.

G. "Dry Shake" Finish: Give the surface a floated finish. Evenly apply approximately 2/3 of a blended unsegregated material:

1. Begin floating immediately after application of first "dry shake".
2. After material has been embedded by floating, apply remainder of blended material to surface at right angles to previous application.
3. Make second application heavier in any areas not sufficiently covered by first application.
4. Immediately follow with second floating.
5. After selected material has been embedded by second floating, complete operation with a broomed, floated, or troweled finish, as indicated.

H. Non-slip Finish: Give surface a "dry shake" application, using crushed ceramically bonded aluminum oxide particles. Apply at 25 pounds per 100 square feet.

I. Exposed Aggregate Finish: Immediately after surface of concrete has been leveled to tolerance and surface water has dissipated, spread aggregate uniformly over surface to provide complete coverage to the depth of a single stone:

1. Embed aggregate into surface by light tamping.
2. Float surface until embedded aggregate is fully coated with mortar and surface has been brought to tolerance.
3. Start exposure of aggregate after matrix has hardened sufficiently to prevent dislodgment.
4. Flow ample quantities of water, without force, over surface of concrete while matrix encasing aggregate is removed by brushing with a fine bristle brush.
5. Continue until aggregate is uniformly exposed.
6. An approved chemical retarder sprayed onto freshly floated surface may be used to extend working time.

J. Chemical-Hardener Finish: Apply liquid chemical-hardener finish to interior concrete floors where indicated. Do not apply liquid chemical hardener on floor areas scheduled to receive synthetic matrices terrazzo, setting beds for tile, terrazzo, vinyl flooring, or like items. Apply hardener after complete curing and drying of concrete surface per manufacturer's recommendations. Evenly apply each coat, and allow 24 hours for drying between coats. After final coat of chemical-hardener solution is applied and dried, remove surplus hardener by scrubbing and mopping with water.

3.3 FINISHING FORMED SURFACES

A. General:

1. Allow concrete to cure not more than 72 hours before commencing surface finish operations, unless approved otherwise.
2. Revise the finishes as needed to secure approval.

B. As-Cast Form Finish:

1. Rough: Patch defects, chip or rub off fins exceeding 1/4 inch height.
2. Smooth: Patch tie holes and defects and remove fins completely:
   a. When surface texture is impaired and form joints misaligned, grind, bush-hammer, or correct affected concrete.
   b. Slurry grout areas evidencing minor mortar Leakage to match adjacent concrete.
   c. Repair major mortar Leakage as a defective area.
   d. When workmanship is less than acceptable standard, provide one of rubbed finishes at no additional cost to OWNER.

C. Rubbed Finishes:

1. Smooth: Remove forms and perform necessary patching as soon after placement as possible:

   a. Finish newly hardened concrete no later than 24 hours following form removal.

   b. Wet surfaces and rub with carborundum brick or other abrasive until uniform color and texture are produced.

2. Grout Cleaned: Undertake no cleaning operations until all contiguous surfaces are completed and accessible:

   a. Wet surface of concrete sufficiently to prevent absorption of water from grout.

   b. Apply grout uniformly.

   c. Immediately after grouting, scrub surface with cork float or stone to coat surface and fill voids.

   d. While grout is still plastic, remove excess grout by working surface with rubber float or sack.

   e. After surface whitens from drying, rub vigorously with clean burlap.

   f. Keep damp for at least 36 hours after final rubbing.

3. Cork Floated: Remove forms within two (2) to three (3) days of placement where possible:

   a. Remove ties.

   b. Remove all burrs and fins.

   c. Dampen wall surface.

   d. Apply mortar with firm rubber float or with trowel, filling all surface voids.

   e. Compress mortar into voids.

   f. If mortar surface dries too rapidly to permit proper compaction and finishing, apply a small amount of water with fog sprayer.

   g. Produce final texture with cork float using a swirling motion.

D. Unformed Finish:

1. After concrete is placed, strike smooth, tops of walls or buttresses, horizontal offsets, and similar unformed surfaces occurring adjacent to formed surfaces.

2. Float to texture that is reasonably consistent with formed surfaces.

3. Continue final treatment on formed surfaces uniformly across uniformed surfaces.

E. Blasted Finish:

1. Perform abrasive blasting within 24 to 72 hours after casting.

2. Coordinate with form work construction, concrete placement schedule, and formwork removal to ensure that surfaces are blasted at the same age for uniform results.

3. Reapply curing protection after blast finishing

F. Architectural Finish, ACI 303:

1. Tooled Finish:

a. Dress thoroughly cured concrete surface with electric, air, or hand tools to uniform texture, and give a bush hammered surface texture.

b. Remove sufficient mortar to exposed coarse aggregate in relief and to fracture coarse aggregate for tooled finish.

G. Patched Finish:

1. Repair defective areas:

a. Remove honeycomb and defective concrete to sound concrete.

b. Make edges perpendicular to surface or slightly undercut.

c. Feather edges are not permitted.

d. Dampen area to be patched and at least six (6) inches surrounding it to prevent absorption of patching mortar water.

e. Prepare bonding grout.

f. Mix to consistency of thick cream.

g. Brush into surface.

2. Tie Holes: Unless indicated otherwise, after being cleaned and thoroughly dampened, fill tie hole solid with patching mortar.

3. Make patches in concrete closely match color and texture of surrounding surfaces. Determine mix formula for patching mortar by trial and obtain a good color match with concrete when both patch and concrete are cured and dry:

a. Mix white and gray Portland cement as required to match surrounding concrete to produce grout having consistency of thick paint.

b. Use a minimum amount of mixing water.

c. Mix patching mortar in advance and allow to stand without frequent manipulation, without addition of water, until it has reached stiffest placeable consistency.

d. After initial set, dress surfaces of patches manually to obtain same texture as surrounding surfaces.

4. After surface water has evaporated from patch area, brush bond coat into surface:

a. When bond coat begins to lose water sheen, apply patching mortar.

b. Thoroughly consolidate mortar into place and strike-off to leave patch slightly higher than surrounding surface.

c. Leave undisturbed for at least one (1) hour before final finish.

d. Keep patched area damp for 72 hours or apply curing compound.

e. Do not use metal tools in finishing an exposed patch.

5. Where as-cast finishes are indicated, total patched area may not exceed 1 in 500 of as-cast surface. This is in addition to form tie patches, if ties are permitted to fall within as-cast areas.

6. In any finishing process which is intended to expose aggregate on surface, patched areas must show aggregate:

a. Outer 1 inch of patch shall contain same aggregate as surrounding concrete.

b. For aggregate transfer finish, patching mixture shall contain same selected colored aggregates.

c. After curing, expose aggregates together with aggregates of adjoining surfaces by same process.

END OF SECTION

SECTION 03 39 00
CONCRETE CURING

PART 1 GENERAL

1.1. **SECTION INCLUDES**

A. Concrete curing requirements.

1.2 **REFERENCES**

A. **ACI Standards**:

301 Structural Concrete for Buildings.

305 Hot Weather Concreting.

306 Cold Weather Concreting.

B. **ASTM Standards**:

C171 Sheet Materials for Curing Concrete.

C1315 Liquid Membrane-Forming Compounds Having Special Properties for Curing and Sealing Concrete.

1.3 **SUBMITTALS**

A. Curing agent data sheet.

B. Curing plan. Describe estimated cure quantity and procedure.

C. Manufacturer certificates, Section 01 33 00 that shows product meets performance criteria.

D. Manufacturer's recommended installation procedures which, when accepted by ENGINEER, will become the basis for accepting or rejecting installed product.

1.4 **QUALITY ASSURANCE**

A. Use workers knowledgeable of ACI 301, 305, 306.

1.5 **PRODUCT HANDLING**

A. Protect materials of this Section before, during, and after installation.

B. Protect the work and materials of other trades.

C. In the event of damage, immediately make replacements and repair at no additional cost to OWNER.

1.6 **WEATHER LIMITATIONS**

A. Above 75 deg F, ACI 305

B. Below 55 deg F, ACI 306.

PART 2 PRODUCTS

2.1 COVERS

A. Water or Fog-spay: Clean, non-staining and non-detrimental to concrete.

B. Sheet Coverings: White waterproof paper, polyethylene film, or polyethylene coated burlap sheet complying with ASTM C171.

C. Mat Coverings: Clean roll goods of cotton or burlap fabric.

D. Insulating Coverings: Non-staining curing blankets.

2.2 MEMBRANE FORMING COMPOUND

A. Material:
   1. Styrene-acrylic.
   2. Styrene-butadiene.
   3. Alpha-methylstyrene.

B. Reference: ASTM C1315:
   1. Type II Class A or B (white pigmented).
   2. Type ID Class A (clear with fugitive dye).

C. Volatile Organic Compounds (VOC): Comply with local, state and federal requirements.

PART 3 EXECUTION

3.1 PREPARATION

A. *DO NOT DILUTE CURING COMPOUNDS.*

B. Do not use membrane forming curing compound on surfaces that are to receive hardeners.

C. Commence curing operation within 20 minutes after finishing.

3.2 APPLICATION – COVERS

A. Water: Apply water-fog spray or ponding.

B. Absorptive Mat: Place absorptive mat to provide coverage of concrete surfaces and edges. Lap over adjacent absorptive covers. Thoroughly saturate with water and keep continuously wet.

C. Moisture-Retaining Sheet: Place cover in widest practicable width with sides and ends lapped and sealed to prevent moisture loss. Repair any holes or tears during curing period.

D. Formed Surface Curing: Cure formed concrete surfaces, including underside of beams, supported slabs and other similar surfaces by moist curing with forms in place for full curing period. If forms are removed before curing completion, applying cure film or penetrant or use methods indicated above, as applicable.

3.3 APPLICATION – MEMBRANE FORMING COMPOUND

A. Apply coating continuously and uniformly. Follow manufacturer's recommendations.

B. Protect continuity of film coatings and repair damage during cure period.

C. If forms are removed before expiration of cure period, apply coating to unprotected areas.

3.4 CONCRETE CURE TEMPERATURE

A. During cure period, eliminate thermal shock of concrete by keeping cure temperature even throughout extent and depth of concrete.

3.5 SCHEDULE

A. Concrete Exposed to Potable Water (as in Water Storage reservoirs):
   1. Moisture cover curing, or
   2. Acrylic cure, or
   3. Styrene acrylic silane co-polymer cure.

END OF SECTION

SECTION 03 40 00
PRECAST CONCRETE

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Pre-cast concrete, complete with required connecting and supporting devices.

1.2 REFERENCES

A. **ACI Standards**:

318 Building Code Requirements for Reinforced Concrete. This reference standard includes ASTM material standards.

B. **ASTM Standards**:

A36: Structural Steel.

C478 Precast Reinforced Concrete Manhole Sections.

C857 Minimum Structural Design Loading for Underground Precast Concrete Utility Structures.

C858 Underground Precast Concrete Utility Structures.

C891 Installation of Underground Precast Concrete Utility Structures.

C. **AWS Standards**:

D1.1 Structural Welding Code Steel.

D1.4 Structural Welding Code Reinforcing Steel.

D. **PCI Standards**:

Design Handbook.

MNL-116 Quality Control and Assurance for Plant Production of Prestressed Concrete.

MNL-117 Quality Control and Assurance for Plant Production of Architectural Precast Concrete.

1.3 DESIGN CRITERIA

A. Design structural precast concrete units, ACI 318 and PCI design handbook.

B. Design utility precast units, ASTM C857 and C858.

C. Under direct supervision of a design professional who is fully experienced in design of units.

D. Design units to support required stripping and handling loads, and live, dead and construction loads.

E. Design component connections to provide adjustment to accommodate misalignment of structure during installation.

1.4 SHOP DRAWINGS

A. Prepare Shop Drawings under seal of a licensed design professional.

B. Submit Shop Drawings, Section 01 33 00.

C. Indicate unit locations, unit identification marks, fabrication details, reinforcement, connection details, pertinent dimensions, and erection support points. Unit identification marks to appear on all manufactured units.

D. Do not proceed with fabrication until Shop Drawings have been accepted.

1.5 QUALITY ASSURANCE

A. Manufacturer:
   1. Prestressed: PCI certified.
   2. Precast Concrete Units: PCI or NPCA certified
   3. Precast Utility Structures and Pipe: ACPA certified.

B. Transporter: Acceptable to manufacturer.

C. Erector:
   1. Prestressed: PCI certified.
   2. Precast: Has five (5) years minimum experience in erecting precast units.

D. Welders: Certified, AWS D1.1 and AWS D1.4.

1.6 DELIVERY, STORAGE AND HANDLING

A. Handle precast units in positions consistent with their shape and design. Lift and support only from support points indicated on Shop Drawings.

B. Embedded Lifting or Handling Devices: Capable of supporting units in positions anticipated during manufacture, storage, transportation, and erection.

C. Block and laterally brace units while stored at manufacturers. Provide lateral bracing that is sufficient to prevent bowing and warping that is clean, nonstaining, and will not inhibit uniform curing of exposed surfaces.

D. Provide edges of units with adequate protection to prevent staining, chipping, or spalling of concrete.

E. Unless otherwise approved in writing, do not deliver units to job site until required for installation.

PART 2 PRODUCTS

2.1 CONCRETE

A. Above Ground: 5000 psi minimum, Section 03 30 04 and ACI 318.

B. Underground: Class 4000 minimum, Section 03 30 04 and ASTM C478 or ASTM C858.

2.2 ACCESSORIES

A. Connecting and Supporting Devices: Steel, ASTM A36.

B. Bolts, Nuts, and Washers: High-strength steel. Section 05 05 23.

C. Reinforcement: Grade 60 billet steel bars, Section 03 20 00 plain finish

2.3 FABRICATION

A. Maintain plant records and quality control program during production of structural precast concrete. Make records available to ENGINEER.

B. Use molds which are rigid and constructed of material that will result in uniform finished products.

C. If self consolidating concrete is NOT used, vibrate concrete to ensure proper consolidation, elimination of unintentional cold joints, and minimize entrapped air on surface.

D. Fabricate required connecting devices, plates, angles, items fit to steel framing members, bolts and accessories.

E. Ensure reinforcing steel, anchors, inserts, plates, angles, and other cast-in items are sufficiently embedded, anchored and property located.

F. Ensure finished surfaces of precast structural units are uniform.

G. Cure units under identical conditions to develop specified concrete quality, and minimize appearance blemishes such as non-uniformity, staining or surface cracking.

2.4 DESIGN DEVIATIONS

A. Deviation: Provide installation equivalent to basic intent without additional cost to OWNER. Deviations from exact required cross-section will be permitted only with approval.

B. Manufacturer's Proposed Design: Supported by complete design calculations and drawings. When requested, submit design calculations for review bearing seal and signature of a licensed design professional.

2.5 OPENINGS

A. Provide required openings, six (6) inches or larger. If approved, smaller sizes may be field constructed by coring or sawing.

2.6 FINISHES

A. General: Required finish will be described in one of the following paragraphs. If no finish is indicated or selected by ENGINEER, provide Standard Finish.

B. Standard Finish: Produced in forms such as plastic or metal lined that impart a smooth finish to the concrete. Small surface holes, normal form joint marks, minor chips and spall are acceptable if approved. Major or unsightly imperfections, honeycomb or structural defects are not acceptable.

C. Commercial Finish: Produced in forms such as plywood or lumber that impart texture to concrete. Remove fins and large projections. Fill holes over 3/8 inch. Make faces true and well defined. Correct exposed ragged edges by rubbing or grinding.

D. Architectural Grade A Finish: Produced in forms such as plastic or metal lined that impart smooth finish to concrete. Fill holes over 1/4 inch in diameter with sand-cement paste. Grind smooth form offsets or fins over 1/8 inch. Coat with neat cement paste using float. After paste coat has dried, rub with burlap to remove loose particles.

E. Architectural Grade B Finish: Produced in forms such as plastic or metal lined that impart smooth finish to concrete. Fill holes over 1/4 inch in diameter with sand-cement paste. Grind smooth form offsets or fins over 1/8 inch.

F. Special Finishes: Sandblasting, acid washing, retarders or form liners as approved by ENGINEER. Special finishes require submittal of two 12 x 12 inch Samples showing a representative color and texture to be used.

G. Painted Finishes: On concrete to be painted, use a form release agent acceptable to the paint manufacturer.

2.7 **REPAIR**

A. Repair of damaged units is acceptable if structural integrity or appearance is not impaired.

2.8 **ALLOWABLE TOLERANCES**

A. Length: Plus or minus 3/4 inch, or plus or minus 1/8 inch per 10 feet of length, whichever is greater, or as indicated.

B. End Squareness: 1/2 inch maximum.

C. Blockouts: 1 inch of centerline location indicated.

PART 3 EXECUTION

3.1 **INSTALLATION**

A. Do not install precast units until concrete has attained its design compressive strength.

B. Install members plumb, level, and in alignment within PCI MNL-116 or PCI MNL-117 and indicated limits of erection tolerances.

C. Clean weld marks or other marks, debris, or dirt from exposed surfaces of units.

D. Install underground utility precast units per ASTM C891.

3.2 **PERFORMANCE REQUIREMENTS**

A. Conduct inspections, perform testing, and make repairs or replace unsatisfactory precast units as required.

B. Rejection: Units may be rejected for any one of the following:
   1. Exceeding specified installation tolerances.
   2. Damaged during construction operations.
   3. Exposed-to-view surfaces which develops surface deficiencies.
   4. Other defects as listed in PCI MNL-116 or PCI MNL-117.

END OF SECTION

SECTION 03 61 00
CEMENTITIOUS GROUTING

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Pre-mixed non-metallic shrinkage resistant grout, pre-mixed water stop hydraulic cement grout, epoxy grout, and Portland cement grout:

1. Grout for leveling beds of structural steel plates.
2. Sealing of joints and gaps between piping and structures.
3. Sealing of joints between construction components.

1.2 REFERENCES

A. **ASTM Standards**:

C109	Compressive Strength of Hydraulic Cement Mortars (Using 2 in. or 50 mm Cube Specimens).
C144	Aggregate for Masonry Mortar.
C150	Portland Cement.
C190	Tensile Strength of Hydraulic Cement Mortars.
C207	Hydrated Lime for Masonry Purposes.
C472	Physical Testing of Gypsum Plasters and Gypsum Concrete.
C595	Blended Hydraulic Cements.
C881	Epoxy - Resin - Base Bonding Systems for Concrete.
C1090	Measuring Changes in Height of Cylindrical Specimens from Hydraulic-Cement Grout.
C1107	Packaged Dry Hydraulic Cement (Non-Shrink).
C1157	Blended Hydraulic Cement.
D570	Water Absorption of Plastics.
D638	Tensile Properties of Plastics.
D695	Compressive Properties of Rigid Plastics.

1.3 SUBMITTALS

A. Grout mix components. Indicate proportions used, environmental conditions, and admixture limitations. Indicate material "Type", "Grade", and "Class" which suits Project requirements.

B. Manufacturer's data for latex bonding agent.

PART 2 PRODUCTS

2.1 MATERIALS - GENERAL

A. Cement:

1. Portland: Natural color Type II (normal) or Type IIA (air entrained), ASTM C150.
2. Blended: ASTM C595 or C1157.

B. Lime: Type S, hydrated, ASTM C207.

C. Water: Clean, non-staining, non-detrimental.

D. Aggregate: Standard masonry type, ASTM C144.

2.2 PORTLAND CEMENT GROUT

A. Proportions by Volume: One part Portland cement, and sand equal to 2-1/2 to three times sum of volumes of cement and lime.

B. Mix thoroughly with water to form a stiff workable plastic putty.

C. Compressive Strength: 2800 psi in 28 days, ASTM C109.

2.3 GYPSUM PLASTER GROUT

A. Premixed, prepackaged, wood fiber gypsum plaster with an ASTM C472 minimum average dry compressive strength of 2000 psi in 28 days.

B. Mix with water per manufacturer's instructions for intended use to form a stiff plastic mix required for workability.

2.4 CEMENT BASED SHRINKAGE RESISTANT GROUT

A. Grade B or Grade C: ASTM C1107. Premixed, non-metallic, non-gaseous product at a fluid consistency (flow cone) of 20 to 30 seconds. Thirty-minute-old grout shall flow through flow cone after slight agitation, in temperatures of 40 deg F to 90 deg F

B. Bleeding: None.

C. Compressive Strength: 6500 to 9000 psi in 28 days, ASTM C109.

D. Non-shrink percentage: 0.5 percent, ASTM C1090.

2.5 EPOXY ADHESIVE GROUT

A. Two component material, ASTM C881. Suitable for use on dry or damp surfaces, 100 percent solids, high modulus, moisture insensitive:

1. Tensile Strength: 5000 psi minimum in 14 days, ASTM D638.
2. Tensile Elongation: Two (2) percent minimum, ASTM D638.
3. Compressive Strength: 6500 psi minimum in 24 hours and 70 deg F, 12,500 psi in 28 days and 70 deg F , ASTM D695.
4. Water Absorption: One percent maximum, ASTM D570.
5. Bond Strength:

a. Direct Shear: 400 psi.

b. Direct Tension: 250 psi.

c. Beam Break: 800 psi.

6. Pot Life: Five minutes maximum at 70 deg F

2.6 **BONDING GROUT**

A. Of approximately one part cement to one part fine sand passing a No. 30 sieve with approved latex bonding agent when allowed.

2.7 **PNEUMATICALLY PLACED PLASTER ("GUNITE" OR "SHOTCRETE")**

A. Materials: Portland cement, lime, water and sand.

B. Compressive Strength: 2800 psi in 28 days, ASTM C109.

C. Proportioning: One part cement to not more than five parts sand.

PART 3 EXECUTION

3.1 **INSTALLATION**

A. Fill joints, voids, and pockets, completely.

B. Comply with manufacturer's instructions and UBC Chapter 47.

C. Finish surfaces exposed to view smooth.

D. Pneumatically Placed Plaster: Screened and reused rebound material in an amount not greater than 25 percent of the total sand in any batch.

END OF SECTION

DIVISION 31

EARTH WORK

SECTION 31 05 10

BOUNDARY MARKERS AND SURVEY MONUMENTS

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Materials and procedures for installing boundary markers and survey monuments.

1.2 PERFORMANCE REQUIREMENTS

A. Identify the land surveyor who set the marker plates and reference marks.

B. For vertical control datum use Mean Sea Level datum adjusted by United States Coast and Geodetic Survey for the location of survey.

C. Vertical Accuracy: 3rd order.

D. Make all individual tape measurements to the nearest 0.01 of a foot, with tape corrections for temperature, sag, suspension, etc. noted on all field notes requiring such measurements.

E. Horizontal Accuracy:

1. 1:10,000 minimum for urban areas.
2. 1:20,000 minimum for metropolitan areas.

1.3 SUBMITTALS

A. Survey notes and drawings showing:

1. All monuments found, set, reset, or replaced, describing their kind, size, and location and giving other data relating thereto.
2. Lines of survey, concrete structures containing reference marks, types of marks installed, distances and angles from monument referenced.
3. Witness monuments, basis of bearings, bearings, length of lines to monuments or corners witnessed and scale of drawing.
4. Errors of closure and method of adjustment.
5. Memorandum of oaths and certificates.
6. Narrative describing purpose of survey.
7. Any other data necessary for the interpretation of various items and locations for points, lines, and areas shown.

B. Copies of plats filed with the County Recorder.

1.4 **QUALITY ASSURANCE**

A. Use a land surveyor who complies with Utah licensing law and who is acceptable to OWNER to supervise setting or resetting of monuments and boundary markers.

B. Make surveys in conformance with accepted practice of land surveying and comply with all pertinent Laws and Regulations of land survey regulatory agencies and authority having jurisdiction.

PART 2 PRODUCTS

2.1 **MONUMENT**

A. Monument Post: Minimum three (3) feet long, precast or cast-in-place concrete. Make exposed surface of finished monument posts uniform, even texture, and free of holes, cracks, and chipped edges.

B. Marker Plate: Brass or bronze or as indicated.

2.2 **FRAME AND COVER**

A. Asphalt coated, heavy duty, cast iron, Section 05 56 00.

2.3 **LOT LINE WITNESS MARKER**

A. Brass surveyor's tag or brass nail set in a lead filled hole in concrete.

2.4 **REBAR CORNER MARKER**

A. No. 5 rebar, at least 18 inches long with the top fitted with a nonferrous survey cap and stamped with land surveyor's registration number.

2.5 **PIPE CORNER MARKERS**

A. One (1) inch internal diameter galvanized steel pipe at least 18 inches long, or two (2) inches internal diameter galvanized steel pipe at least 36 inches long.

B. Fit pipe with concrete or mortar plug, tagged with surveyor's license number.

C. Fix tag in concrete or mortar plug with a one (1) inch minimum long bent brass brad.

2.6 **FIELD NOTE PAPER**

A. Twenty (20) pound bond paper minimum with format of documents acceptable to OWNER.

2.7 **CONCRETE**

A. Cast-in-place: Class 4000, Section 03 30 04, or

B. Precast: Class 5000, Section 03 40 00.

PART 3 EXECUTION

3.1 PREPARATION

A. Locate and preserve utilities, Section 31 23 16.

B. Excavation, Section 31 23 16.

3.2 HORIZONTAL CONTROL

A. Set base horizontal ground control upon a minimum of two (2) United States Coast and Geodetic Survey triangulation stations or equivalent, and tie to the Lambert Conformal Conic Projection for establishment of the State Plane Coordinate System with local datum adjustment within the Project area.

3.3 BEARING BASE

A. Refer all directional measurements to one "bearing base". Actual measurements may be equated to bearings and linear measurements shown on any record (i.e., plat, official map, description, or approved field notes of lines resurveyed that are shown on such records used in the survey).

3.4 TIE TO EXISTING MONUMENTS

A. Tie into a monument which has State Plane Coordinates if the monument is within 1/2 mile of the proposed survey site or at a selected location.

3.5 CORNER MARKERS

A. Site Boundary: Install pipe corner markers.

B. Lot Boundary: Install rebar corner markers for lot corners. Do not use rebar where pipe corner markers are installed as a boundary marker and a corner marker.

3.6 LOT LINE WITNESS MARKER

A. Witness lot lines by installing 1/2 inch surveyor tags in sidewalk. If sidewalk does not exist, install tags in curb or mass concrete.

3.7 MONUMENTS

A. Locate monument post so reference point falls within 1 inch diameter circle in the center of marker plate. Install marker plate in survey monument post before the concrete has acquired its initial set.

B. Compact backfill to 95 percent or greater relative to a modified proctor density, Section 31 23 26.

C. Set top of frames and covers 1/4 inch lower than Pavement surface. Recess marker plate a minimum of four (4) inches below cover.

D. Install monument so frame and cover does not contact monument or marker plate.

3.8 DAMAGED MONUMENTS

A. Replace survey control monuments that are disturbed or destroyed by CONTRACTOR.

B. If OWNER allows replacement of lost or destroyed survey control monuments, use a licensed land surveyor to re-establish control monuments based upon original survey control.

3.9 **REFERENCE MARKS**

A. Section 01 71 34.

END OF SECTION

SECTION 31 05 13
COMMON FILL

PART 1 GENERAL

1.1. **SECTION INCLUDES**

A. Common fill material.

1.2 **REFERENCES**

A. **ASTM Standards**:

C136 Sieve Analysis of Fine and Coarse Aggregates.

D448 Classification for Sizes of Aggregate for Road and Bridge Construction.

D1883 CBR (California Bearing Ratio) of Laboratory-Compacted Soils.

D2487 Classification of Soils for Engineering Purposes.

D2844 Resistance R-Value and Expansion Pressure of Compacted Soils.

D3282 Classification of Soils and Soil-Aggregate Mixtures for Highway Construction Purposes.

D3740 Evaluation of Agencies Engaged in Testing and/or Inspection of Soil and Rock as Used in Engineering Design and Construction.

F1647 Organic Matter Content of Putting Green and Sports Turf Root Zone Mixes.

1.3 **SUBMITTALS**

A. **General**. If a change in source of material is required, submit name of Supplier, source and gradation analysis of material before delivery to site.

B. **Topsoil**. Submit certification from topsoil Supplier assuring topsoil product meets requirements in this Section.

C. **Borrow, granular borrow, granular backfill borrow, recycled fill, sand, gravel.** Before delivering material to site, identify:

1. Name of Supplier and source.
2. Gradation, classification and CBR.
3. Percent composition of reclaimed bitumionous concrete or Portland cement concrete included in the mix.

D. **Slag, pumice, scoria**. Identify name of supplier, source, and density.

1.4 **QUALITY ASSURANCE**

A. Use a laboratory that complies with ASTM D3740 and Section 01 45 00 requirements.

B. Reject fill products that do not meet requirements of this section.

C. Remove product found defective after installation and install acceptable product at no additional cost to OWNER.

1.5 **ACCEPTANCE**

A. **General**:

1. Acceptance is by Lot. One (1) lot is one (1) day productionl

2. Dispute resolution, Section 01 35 10.

B. **Roadway Backfill**: Sub-lot size is 5,000 tons.

PART 2 PRODUCTS

2.1 **BORROW**

A. Classifications A-1-a through A-4, ASTM D3282.

2.2 **GRANULAR BORROW**

A. Classifications A-1-a, A-1-b, A-2-4, or A-3, ASTM D3282.

B. Material meets design CBR-value (ASTM D1883) or R value (ASTM D2844) for suitability of source, not for project control testing.

2.3 **GRANULAR BACKFILL BORROW**

A. Classification A-1, ASTM D3282.

B. Well graded.

C. Particle size, two (2) inch maximum.

D. Material meets design CBR-value (ASTM D1883) or R value (ASTM D2844) for suitability of source, not for project control testing.

2.4 **RECYCLED FILL**

A. Material: Pulverized Portland cement concrete, pulverized bitumionous concrete pavement or combination, either mixed with or not mixed with a new aggregate.

B. Gradation: Meet requirements of this section based upon use; e.g. borrow, granular borrow, granular backfill borrow, etc.

2.5 **NATIVE**

A. When allowed by ENGINEER, material obtained from Excavations may be used as fill, provided organic material, rubbish, debris, and other objectionable materials are removed and CONTRACTOR has submitted the appropriate proctor density data (see Section 31 23 26).

2.6 **CLAY**

A. Classification CL, CL-ML, or ML, ASTM D2487.

B. Free of organic matter, frozen material, debris, rocks, and deleterious

materials.

C. Homogeneous, relatively uniform.

2.7 **SAND**

A. Friable river or bank aggregate, free of loam and organic matter. Graded as follows.

Sieve	**Percent Passing by Weight**
3/8	100
100	1 – 10

2.8 **GRAVEL**

A. Material: Rock, stone, or other high quality mineral particle or combination.

Sewer Rock.

Nominal Size	ASTM Size No.
3.5 to 1.5”	1
2.5 to 1.5”	2
2 to 1”	3
1.5 to 3/4”	4
1 to 1/2"	5

Pea Gravel.

Nominal Size	ASTM Size No.
3/4 to 3/8”	6
1/2 to No. 4	7
3/8 to No. 8	8
No. 4 to No. 16	9
No. 4 (screenings)	10

2.9 **TOPSOIL**

A. Chemical Characteristics:

1. Acidity and alkalinity range: pH 5.5 to 7.7
2. Soluble Salts: Less than 2.0 mmhos/cm.
3. Sodium Absorption Ratio (SAR): less than 3.0
4. Nitrogen (NO_3N): 48 ppm minimum
5. Phosphorus (P): 11 ppm minimum
6. Potash (K): 130 ppm minimum
7. Iron (Fe): 5.0 ppm minimum

B. Physical Characteristics:

1. Fertile, loose, friable.
2. Free of weeds, subsoil, lumps or clods of hard earth, plants or their roots, sticks, toxic minerals, chemicals and stones greater than 1-1/2 inch diameter.

3. Composition, ASTM D2487:

Material	Percent
Sand	15 – 60
Silt	10 – 70
Clay	5 – 30
Organic matter	2 - 5

Humus determined by ASTM F1647. Peat may be used as an organic amendment to meet the humus requirements.

2.10 SLAG, PUMICE, SCORIA

A. Chemically inert, porous, durable, free draining.

Table 1 – Gradation and Density				
Criteria		**Slag**	**Pumice**	**Scoria**
Gradation, US Sieve	3”	100	100	100
	1 1/2"	80 – 100	80 – 100	80 – 100
	3/4"	20 – 100	--	--
	3/8”	0 – 20	0 – 20	40 – 100
	No. 4	0 – 10	0 – 10	10 – 70
	No. 16	--	0 – 65	0 – 40
	No. 50	--	0 – 40	0 – 25
	No. 200	0 – 3	0 – 3	0 – 15
Density, pound per cubic foot		85 – 100	75 – 80	60 – 75
NOTES: (a) Gradations are based upon percent of material passing sieve by weight, ASTM C136. (b) Density measured as in-place target.				

2.11 SOURCE QUALITY CONTROL

A. Verify gradation, ASTM C136.

B. Select samples on a random location and time basis.

C. If tests indicate materials do not meet specified requirements, change materials and retest at no additional cost to OWNER.

PART 3 EXECUTION

Not Used

END OF SECTION

SECTION 31 05 19
GEOTEXTILES

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Geotextile fabrics.

1.2 REFERENCES

A. **ASTM Standards**:

D146	Sampling and Testing Bitumen-Saturated Felts and Woven Fabrics for Roofing and Waterproofing.
D276	Identification of Fibers in Textiles.
D882	Tensile Properties of Thin Plastic Sheeting.
D3786	Hydraulic Bursting Strength of Knitted Goods and Nonwoven Fabrics - Diaphragm Bursting Strength Tester Method.
D4354	Sampling of Geotextiles for Testing.
D4355	Deterioration of Geotextiles from Exposure to Ultraviolet Light and Water (Xenon - Arc Type Apparatus).
D4491	Water Permeability of Geotextiles by Permittivity.
D4533	Trapezoid Tearing Strength of Geotextiles.
D4632	Breaking Load and Elongation of Geotextiles (Grab Method).
D4751	Determining Apparent Opening Size for a Geotextile.
D4759	Determining Specification Conformance of Geosynthetics.
D4833	Index Puncture Resistance of Geotextiles, Geomembranes, and Related Products.
D4873	Identification, Storage, and Handling of Geotextiles.
E96	Water Vapor Transmission of Materials.
E154	Testing Materials for Use as Vapor Barriers Under Concrete Slabs and as Ground Cover in Crawl Spaces.

1.3 DEFINITIONS

A. **MARV**: Acronym for minimum average roll value. A statistical value of a particular test property embracing 95 percent confidence level of all possible values of that property. For a normally distributed set of data, it is approximately the mean value plus and minus two standard deviations.

B. **Permitivity**: - of geotextiles, the volumetric flow rate of water per unit cross sectional area per unit head under laminar flow conditions, in the normal direction through a geotextile.

1.4 **SUBMITTALS**

A. Submit before use:

1. Sample of geotextile.
2. Manufacturer's certificate that each fabric complies with requirements of this section.

1.5 **DELIVERY STORAGE AND HANDLING**

A. Label fabric, ASTM D4873.

B. Deliver geotextile dry, in a wrapping that protects it from the elements during shipping and storage. Keep fabric dry.

C. Protect geotextile from ultraviolet light and temperature greater than 140 deg F until application.

1.6 **QUALITY ASSURANCE**

A. Provide manufacturer’s on-site technical supervision and assistance.

PART 2 PRODUCTS

2.1 **GEOTEXTILE - GENERAL**

A. **Stated values in this section are for non-critical, non-severe applications.**

B. Fabric consists of synthetic fibers at least 85 percent by weight of polyolefins, polyesters or polyamides.

C. Resistant to chemical attack, rot and mildew.

D. No tears or defects that adversely alter fabric's physical properties.

E. All numerical values represent minimum average roll values in the weaker principal direction.

2.2 **STABILIZATION-SEPARATION GEOTEXTILES**

A. Woven or non-woven fabric. Meet the following properties and survivability ratings.

Table 1 – Stabilization-Separation Geotextile					
	Standard	MARV			
		Moderate		High	
		Woven	Non Woven	Woven	Non Woven
Grab tensile strength, lbs.	D4632	180	115	270	180
Grab elongation, percent	D4632	<50	>50	<50	>50
Trapezoid tear, lbs.	D4533	70	40	100	75
Puncture resistance, lbs.	D4833	70	40	100	60
Apparent opening size (AOS), US sieve, minimum.	D 4751	30	60	30	60

Construction Survivability

Subgrade, CBR	1		1 – 2		> 2	
Tire pressure, psi	<50	>50	<50	>50	<50	>50
6 inches cover thickness	NR	NR	H	H	M	M
12 inches cover thickness	NR	NR	H	M	M	M
18 inches cover thickness	H	M	M	M	M	M

NOTES
(a) H = High; M = Medium; NR = Not Recommended

2.3 SILT FENCE GEOTEXTILE

A. Use woven fabric. Meet standard or high performance properties:

Table 2 – Silt Fence Geotextile			
	Standard	MARV	
		Standard	High
Grab tensile strength, lbs.	D4632	90	120
Grab elongation, percent	D4632	< 40	< 40
Flux, gal/min/ft^2	D4491	15	90
Apparent opening size (AOS), US sieve, minimum.	D4751	20	30
Ultraviolet degradation, percent	D4355	70	90

NOTES
(a) Percent of grab elongation retained determined after ultraviolet light and water, ASTM D4355 for 500 hours.
(b) No deviation from any requirement due to presence of seams.

B. High performance fence to have tape yarns in one principle direction only.

C. Add stabilizers or inhibitors to make filaments resistant to sunlight or heat deterioration.

D. Finish edges to prevent outer yarn from pulling away from the fabric.

E. Sheets of fabric may be sewn or bonded together. Provide minimum width recommended by manufacturer.

F. Manufactured with pockets for posts, hems with cord, or with posts pre-attached using staples or button head nails.

2.4 EROSION CONTROL GEOTEXTILES

A. Class A erosion control applications are those where the geotextile is used under conditions where installation stresses are greatest (more severe than Class B), i.e., stone placement height should be no more than five (5) feet and stone weights should not exceed 250 pounds.

B. Class B erosion control applications for geotextiles are used under conditions where installation stresses are more severe than Class C, i.e., stone placement height should be less than three (3) feet and stone weights should not exceed 250 pounds.

C. Class C erosion control applications are those where the geotextile is used in structures or under conditions where the geotextile is protected by a sand cushion or by "zero drop height" placement of stone.

D. Use woven or non-woven fabric.

Table 3 – Erosion Control Geotextile

	Standard	MARV		
		Class A	Class B	Class C
Grab tensile strength, lbs.	D4632	300	200	100
Grab elongation, percent, min.	D4632	15	50	50
Puncture resistance, lbs.	D4833	100	60	30
Trapezoid tear, lb.	D4533	80	50	40
Flux, gal/min/ft^2	D4491	25	25	25
Apparent opening size (AOS), US sieve, minimum	D4751	60	60	60
Ultraviolet degradation, percent	D4355	70	70	70
Permittivity, sec.$^{-1}$	D4491	0.1	0.1	0.1

NOTES

(a) Percent of grab elongation strength retained determined after ultraviolet weathering, ASTM D4355 for 500 hours.

(b) Permittivity number reflects typical not minimum values for this test method only. The k value of the geotextile shall be greater than the k value of the soil.

2.5 ROADWAY PAVEMENT GEOTEXTILES

A. Sheet Fabric: Non-woven. Heat bonded only on one side to assist in preventing bleed through of tack coat and sticking of fibers to wheels of lay-down equipment.

Table 4 – Roadway Paving Geotextile			
	Standard	**MARV**	
		Standard duty	**Heavy Duty**
Grab tensile strength, lbs.	D4632	80	120
Grab elongation, percent	D4632	50	50
Asphalt retention, gal/yd^2	--	0.2	0.3
Melting point, deg F	D276	300	300
Ultraviolet degradation, percent	D4355	70	70
Apparent opening size (AOS), US sieve, minimum	D4751	60	60
NOTES (a) Percent of grab elongation retained determined after ultraviolet weathering, ASTM D4355 for 500 hours.			

B. Crack Patch Fabric: Needle-punched non-woven coated with an Asphalt Binder and a rubberized asphalt adhesive.

Table 5 – Crack Patching Geotextile		
	Standard	**MARV**
Strip tensile, lbs/in.	D882	50
Puncture resistance, lb	E154	200
Permeance, perms	E69 Method B	0.10 (max)
Pliability	D146	No crack in fabric or rubberized asphalt
NOTES (a) Strip tensile uses 12 inch/minute test speed and 1 inch initial distance between grips. (b) Pliability uses 180 degree bend on 1/4 inch mandrel at –25 deg F		

2.6 DRAINAGE GEOTEXTILES

A. Class A drainage applications are for fabrics where installation stresses are more severe than Class B, i.e. very coarse sharp angular aggregate is used, a heavy degree of compaction (greater than or equal to 95 percent relative to a standard proctor density, Section 31 23 26) is specified, or depth of trench is greater than 10 feet deep.

B. Class B drainage applications are those where fabric is used with smooth graded surfaces having no sharp angular projections, no sharp angular aggregate, compaction requirements are light, (less than 95 percent standard proctor, Section 31 23 26), and trenches are less than 10 feet deep.

C. Use non-woven fabric.

Table 6 – Drainage Geotextile			
	Standard	**MARV**	
		Class A	**Class B**
Grab tensile strength, lbs.	D4632	200	100
Grab elongation, percent, minimum	D4632	50	50
Puncture strength, lbs.	D4833	60	30
Trapezoid tear, lbs.	D4533	50	40
Flux, gal/min/ft^2	D4491	25	25
Apparent opening size (AOS), US sieve, minimum.	D4751	60	60
Permittivity, sec.$^{-1}$ (b)	D4491	0.1	0.1
NOTES (a) Percent of grab elongation retained determined after ultraviolet weathering, ASTM D4355 for 500 hours. (b) Permittivity number reflects typical not minimum values for this test method only. The k value of the geotextile shall be greater than the k value of the soil.			

2.7 WEED BARRIER GEOTEXTILE

A. Use non-woven fabric.

Table 7 – Weed Barrier Geotextile		
	Standard	**MARV**
		Standard
Grab tensile strength, lbs.	D4632	90
Grab elongation, percent, minimum	D4632	50
Puncture strength, lbs.	D4833	25
Trapezoid tear, lbs.	D4533	30
Apparent opening size (AOS), US sieve, minimum.	D4751	50
Ultraviolet degradation, percent	D4355	70
NOTES (a) Percent of grab elongation retained determined after ultraviolet weathering, ASTM D4355 for 500 hours.		

2.8 POSTS

A. Minimum length, four (4) feet.

B. Steel: Round, U shaped, T shaped, or C shaped with a minimum weight of 1.3 pounds per foot, and have projections for fastening wire.

C. Wood:

1. Soft wood posts at least three (3) inches in diameter, or nominal 2 x 4 inches and straight to provide a fence without noticeable misalignment.

2. Hard wood post providing a minimum cross sectional area of 2.25 square inches.

D. Fasteners for Wood Posts:

1. Wire staples No. 17 gage minimum with a crown at least 3/4 inches wide and legs at least 1/2 inch long.
2. Nails 14 gage minimum, 1 inch long with 3/4 inch button heads.

2.9 SOURCE QUALITY CONTROL

A. Sampling practices, ASTM D4354.

B. Conformance verification, ASTM D4759.

PART 3 EXECUTION

3.1 STABILIZING POOR LOAD BEARING SOILS

A. Remove all organic material larger than 1 inch in diameter from the subgrade and grade to elevations required for overlaying backfill.

B. Compact subgrade to the extent allowed by substrate condition.

C. Roll fabric onto subgrade so subgrade remains smooth. Do not dag.

D. Fold or overlap geotextile in direction of drainage.

Table 8 - Geotextile Overlap

Soil CBR Rating	Overlap Required	
	Unsewn, inches	Sewn, inches
Less than 1	--	4
1 - 2	36	4
2 - 3	30	3
3 - 5	24	--
Greater than 5	18	--

NOTES

(a) Sewn seams both factory and field seams shall conform to 90 percent of the grab tensile strength requirements.

E. Place granular material on top of fabric and spread carefully to insure no puncture. Minimum backfill lift on fabric, six (6) inches.

F. Cover fabric with 12 inches of sand before placing rock larger than four (4) inches diameter on fabric.

G. Avoid sudden stops or turning motions by equipment operating on aggregate placed over the fabric.

H. Compact backfill soils over fabric to 95 percent or greater relative to a standard proctor density, Section 31 23 26.

I. Repair any puncture by covering with new fabric using the same overlap dimensions indicated in Table above.

3.2 SILT FENCE

A. Beginning work means acceptance of existing conditions.

B. The quantity of temporary silt fences may be increased, decreased, or eliminated entirely at CONTRACTOR's discretion at no additional cost to OWNER. Maintain the silt fence until the Work is accepted or until the fence and silt accumulations are removed.

C. Clear area of any debris and obstructions that may damage geotextile.

D. Place post in all low points.

E. Install posts a maximum of eight (8) feet apart with at least 18 inches in the ground. If not possible to achieve depth, secure posts to prevent overturning.

F. Attach filter fabric by wire, cord, pockets, staples, nails, or other effective means:

1. When using a wire support fence, provide at least six (6) horizontal wires with a minimum of 12 gage wire. Space vertical wires six (6) inches maximum. Secure geotextile to the up slope side of the post. Extend wire into the Trench a minimum of two (2) inches and extend a maximum of 36 inches above the ground surface.

G. Install fabric so six (6) to eight (8) inches of fabric is left at the bottom to be buried. Splice together only at support posts with a minimum overlap of 18 inches. Extend buried portion six (6) inches deep and the rest upstream of the fabric fence.

H. Sediment Removal: Remove sediment before deposit reaches 1/2 of the height of the silt fence, or extend height of silt fence. After removal of sediment, dress landscape.

I. Schedule of Locations: Typical locations include the toe of fill slopes, the downhill side of fill slopes, the downhill side of large cut areas, and at natural drainage areas. Limit geotextile materials to handle an area equivalent to 1,000 square feet per 10 feet of fence. Use caution should site slope be steeper than 1:1, and water flow rates exceed 1 cubic foot per second per 10 feet of fence face.

3.3 EROSION CONTROL

A. Install fabric in locations shown on the Drawings.

B. Unless specified elsewhere, overlap geotextile at least 2 feet (2) at all longitudinal and transverse joints, or the geotextile shall be sewn.

C. If overlapped, place geotextile so upstream sheet overlaps downstream sheet.

D. For placement on slopes, overlap the next downhill strip.

E. Anchor the geotextile by using key trenches or aprons at the crest and toe of the slope.

F. Pins, usually 18 inches in length, may be helpful in securing geotextile during installation.

G. Repair: Place patch over damaged area and extend three (3) feet beyond the perimeter of any tear or damage.

3.4 ROADWAY PAVING FABRICS

A. Preparing Bituminous Concrete Surface:

1. Brush road surface clean of debris, dust and gravel. Remove all water from surface and allow to dry.
2. Patch holes and level uneven areas with bituminous concrete.
3. Fill cracks between 1/8 inch to 1/2 inch with asphalt cement. Allow cement to cure before geotextile placement.
4. Clean cracks larger than 1/2 inch to a depth of 3 inches and fill with bituminous concrete. Where pavement is severely cracked, rutted, deformed or distressed, secure approval for providing an bituminous concrete leveling course before geotextile placement.

B. Tacking Bituminous Surface for Pavement Fabric: Use tack asphalt recommended by fabric manufacturer. Apply tack as follows:

1. Dry pavement surface; 0.20 to 0.30 gallons per square yard. Within street intersections, on steep grades and in zones where vehicle speed changes are commonplace, reduce the application rate to no less than 0.20 gallons per square yard.
2. Heavy duty fabrics; 0.30 to 0.40 gallons per square yard.
3. Provide a tack width equal to geotextile width plus six (6) inches.
4. Apply tack only as far in advance of geotextile installation as is appropriate to insure a tacky surface at the time of geotextile placement.
5. Allow tack time to cure with no moisture remaining before placing the geotextile and overlay.
6. Clean excess tack material from the road surface.

C. Fabric Placement:

1. Place fabric into the asphalt tack with a minimum amount of wrinkling or folding. Slit and lay flat wrinkles or folds in excess of 1 inch.
2. Shingle lap all transverse joints and slit folds or wrinkles in the direction of the paving operation.
3. Maximize geotextile contact with the pavement surface by brooming or pneumatic rolling.
4. Additional hand placed asphalt tack may be required at laps and repairs.

D. Protection and Repair:

1. Do not allow traffic except necessary construction equipment and emergency vehicles to drive on the fabric.
2. Turn paver and other vehicles gradually and keep turning to a minimum to avoid movement and damage to the geotextile. Do not permit abrupt starts and stops.
3. Remove and replace damaged geotextile with the same type of geotextile, and shingle lap the overlaps in the direction of paving.

Restrict overlaps to a maximum of six (6) inches.

3.5 **SUBSURFACE DRAINAGE**

A. Excavate trench to size and depth indicated.

B. Cut fabric to width required and place in trench. Prevent damage to geotextile.

C. Overlap geotextile 12 inches or the full width of the trench, whichever is less at the top of trench.

D. Overlap successive pieces of geotextile a minimum of 12 inches in the direction of flow.

E. Place fill to hold fabric in place.

F. Repair any damage to geotextile by placing patches extending three (3) feet in all directions beyond the damaged area.

3.6 **WEED BARRIER**

A. Preparation:

1. Remove sharp objects, large stones and undesirable vegetation.
2. If placing geotextile over existing bed, cut an "X" over each plant and push geotextile under plant base. If placing over new bed, roll geotextile over soil and cut an "X" for each plant hole. Fold excess geotextile under and cover with specified landscaping materials.

B. Surface Cover: Provide at least four (4) inches of cover on all areas on the geotextile unless otherwise specified by ENGINEER. If using large landscape rock, increase thickness of cover material over geotextile to three (3) times the diameter of the largest rock material. Do not leave any portion of geotextile exposed to direct sunlight.

C. Repair: Repair immediately. Clear the damaged area plus an additional three (3) feet and apply geotextile patch.

D. Maintenance: Maintain surfaces and supply additional landscape materials where necessary, including areas affected by erosion.

3.7 **FIELD QUALITY CONTROL**

A. Reject fabric at the time of installation, if it has defects, rips, holes, flaws, deterioration, or damage incurred during manufacture, transportation, handling or storage.

END OF SECTION

SECTION 31 05 21
GEOGRIDS AND GEOCOMPOSITES

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Geogrid and geocomposite reinforcement in embankments, over subgrades, in granular bases, and in roadway pavements.

1.2 REFERENCES

A. **AASHTO Standards:**

R50 Geosynthetic Reinforcement of the Aggregate Base Course of Flexible Pavement Structures

T289 Determining pH of Soil for Use in Corrosion Testing.

B. **ASTM Standards**:

D276 Melting Point Minimum.

D4354 Sampling of Geotextiles for Testing.

D4355 Resistance to Loss of Load Capacity under UV light and Weathering.

D4759 Determining Specification Conformance of Geosynthetics.

D4873 Identification, Storage, and Handling of Geotextiles.

D6637 Determining Tensile Properties of Geogrid.

D7737 Load Transfer Capability.

D7748 Flexural Rigidity of Geogrids, Geotextiles and Related Products.

C. **ASCE Publications:**

1. Giroud, J.P., and Han, J. (2004). "Design Method for Geogrid-Reinforced Unpaved Roads. Part I – Development of Design Method." Journal of Geotechnical and Geoenvironmental Engineering, 130 (8), 775-786.
2. Giroud, J.P., and Han, J. (2004). "Design Method for Geogrid-Reinforced Unpaved Roads. Part II – Calibration and Applications." Journal of Geotechnical and Geoenvironmental Engineering, 130 (8), 787-797.

D. **EPA Standards:**

9090 - Compatibility Test for Wastes and Membrane.

E. **FHWA Standards**:

NHI-09-087 Corrosion/Degradation of Soil Reinforcement for MSE Walls and Reinforced Soil Slopes.

NHI-10-024 Design and Construction of MSE Walls and Reinforced Soil Slopes – Volume I.

NHI-10-025 Design and Construction of MSE Walls and Reinforced Soil Slopes – Volume II.

F. **GRI Standards**:

GG9 Torsional Behavior of Bidirectional Geogrids When Subjected to In-Plane Rotation

1.3 **DEFINITIONS**

A. **BCG**: Acronym for base course geogrid.

B. **Geocomposite**: Fabric composed of a geogrid and either a geotextile or a tack film.

C. **LAG**: Acronym for large aggregate geogrid.

D. **MARV**: Acronym for minimum average roll value (defined in Section 31 05 19).

E. **MSE**: Acronym for mechanically stabilized earth.

F. **SAG**: Acronym for small aggregate geogrid.

1.4 **SUBMITTALS**

A. Submit the following at least one (1) week prior to product placement.

1. Geogrid product data and sample.
2. Geocomposite product data and sample.
3. Manufacturer's warranty.
4. Installer's warranty.
5. Tack coat grade.
6. Information requested by ENGINEER.

B. If a bituminous surface is placed concurrent with the reinforcement, check temperature requirements and minimum thicknesses. Submit daily report to ENGINEER. Report the following.

1. Tack temperature (minimum 4 times per day).
2. Tack application rate (minimum 4 times per day).
3. Bituminous concrete temperatures (minimum 4 times per day).
4. Bituminous concrete thickness (minimum 4 times per day using depth probe after initial breakdown rolling).
5. Average tack application rate based on yield calculation using applicator weights and measured surface area

1.5 **DELIVERY STORAGE AND HANDLING**

A. Label, handle and store product, ASTM D4873.

B. Prevent mud, wet concrete, epoxy or other deleterious materials from coming in contact with and affixing to in-place geogrid and geocomposite materials.

C. Protect product as recommended by the manufacturer. This may include protection from ultraviolet light, moisture, high or low temperatures, or roll orientation during storage.

D. Cover product within 14 days of deployment.

1.6 QUALITY ASSURANCE

A. **Pre-Placement Conference**: Arrange a conference at least 48 hours prior to installation of geogrid or geocomposite. Attendees are ENGINEER, Inspector, Supplier, and installer. Discuss installation and inspection procedures and the following.

1. Location.
2. Overlap.
3. Tensioning (if required).
4. Construction equipment and installation practices.
5. Critical items that can affect design criteria or warranty.

B. **Supplier or Manufacturer**:

1. For embankment installations and mechanically stabilized earth (MSE) structures provide at least two (2) days of on-site supervision and technical assistance.
2. For roadway projects, provide one (1) day's on-site assistance.

1.7 ACCEPTANCE

A. **Pavement Subgrade**: Geogrid equivalence for subgrade stabilization should be determined based on the Giroud-Han method (this section article 1.2).

B. **Roadway Structures**: Geogrids utilized as part of the pavement structure should be reviewed based on the AASHTO R50.

C. **MSE Structures**: If CONTRACTOR requests substituting a rectangular or square geogrid for a triangular geogrid, CONTRACTOR must show the structural benefit and stability of a rectangular or square geogrid is equivalent to or better than the triangular geogrid. As a minimum the following conditions must be met.

1. For large aggregate geogrids (LAG) the aperture pitch is between 1.7 and 2.2 inches.
2. For small aggregate geogrids (SAG) the aperture pitch is between 0.5 and 0.9 inches.

1.8 WARRANTY

A. Manufacturer or Supplier: Warrant product to meet the specifications.

B. Installer: Warrant workmanship for two (2) years.

PART 2 PRODUCTS

2.1 GEOGRIDS AND GEOCOMPOSITES - GENERAL

A. Synthetic fiber at least 85 percent by weight of polypropylene, polyethylene, polyester, polyvinyl alcohol, fiberglass, modified polymer, or polyamide.

B. Resistant to chemical attack, rot and mildew, EPA 9090.

C. No tears or defects that will adversely alter properties of product.

2.2 GEOGRID FOR EMBANKMENTS

A. For environments tested in accordance with AASHTO T289, (FHWA-NKI-09-85):

1. Polypropylene (PP) can be used where pH is 3 or greater. Do not use when pH is below 3.
2. High denisty polyethylene (HDPE) can be used where pH is 3 ot 9. Do not use when pH is below 3 or above 9.
3. Were pH is 3 to 9, high molecular weight (Mn) and low carboxyl end group concentration (CEG) polyester products can be used. Do not use when pH is below 3 or above 9.

Table 1 – Embankment Geogrid

Property	Standard	MARV		
		Type 1	Type 2	Type 3
Ultimate strength, lb/ft	D6637	1500	4000	9000
Long term allowable design strength, lb/ft	(a)	450	1700	3600
Resistance to UV degradation, percent minimum	D4355	95	95	95
Resistance to long term degradation, percent minimum	EPA 9090	100	100	100

NOTES

(a) Long term allowable design strength is calculated by dividing the ultimate tensile strength by the product of the reduction factors for creep, installation damage and degradation for the design period. Values used for these reduction factors must be based on testing outlined by FHWA-NHI-09-087.

2.3 GEOGRID FOR ROADWAY SUBGRADE OR BASE COURSE

A. Base course geogrid (BCG) is used for gradations of aggregate where the median of the aggregate size (D50) is between 0.75-inches and 1.25-inches.

B. Large aggregate geogrid (LAG) is used where (D50) is greater than 1.25-inches.

C. Small aggregate geogrid (SAG) is used where (D50) is less than 0.75-inches.

Table 2 – Subgrade and Base Course Geogrid							
Property	**Standard**	**MARV**					
		BCG		**LAG**		**SAG**	
Rib shape		□	△	□	△	□	△
UV resistance at 500 hours, percent	D4355	70	70	70	70	70	70
Chemical resistance, percent	EPA 9090	100	100	100	100	100	100
Junction efficiency, percent	D7737	90	90	90	90	90	90
Ribs per junction	Observed	4	6	6	6	6	6
Aperture pitch, in.	Measured	1.0–1.3 (a)	1.6 (b)	2.4 (b)	2.4 (b)	1.3 (b)	1.3 (b)
Radial stiffness at 0.5% strain , lb/ft (c)	D6637	--	15,400	23,900	23,900	13,700	13,700
Isotropic stiffness ratio (d)	D6637	--	0.6	0.6	0.6	0.6	0.6
Torsional rigidity at 20 kg.cm, m-N/deg	GG9	6.5	--	--	--	--	--
Flexural rigidity (mg-cm)	D7748	750,000	--	--	--	--	--
Tensile strength at 2% strain (lb/ft)	D6637	400 x 600	--	--	--	--	--
Ultimate tensile strength (lb/ft)	D6637	1300 x 1900	--	--	--	--	--

NOTES

(a) Machine and cross machine direction

(b) Determined by measuring the spacing between sets of parallel ribs in any direction.

(c) ASTM D6637 Method B with a 2 aperture gage length tested in all "rib" and "mid-rib" directions. The radial stiffness is computed as the minimum measured modulus at 0.5 percent strain for each direction.

(d) Minimum measured radial stiffness at 0.5 percent strain divided by the maximum measured radial stiffness at 0.5 percent strain.

2.4 GEOGRID AND GEOCOMPOSITE FOR ROADWAY PAVEMENT

A. Placement is between bituminous pavement layers. Do not use with less than 2-inches of bituminous concrete cover.

B. Polyester geocomposite (PGC) is composed of a high modulus polyester geogrid bonded to a lightweight non-woven fabric.

C. Fiberglass geogrid (FG) is composed of a fiberglass geogrid coated with an elastomeric polymer.

D. Fiberglass geocomposite with a tack film (FGT) is composed of a fiberglass geogrid coated with an elastomeric polymer and bonded to a 100% polymer tack film.

Table 3 – Roadway Pavement Geogrids and Geocomposites				
Property	**Standard**	**MARV**		
		PGC	**FG**	**FGT**
Opening size, in.	Measured	0.5-1.0	0.5-1.0	0.5-1.0
Ultimate tensile strength, lb/ft	D6637	3425 x 3425	6720 x 6720	6720 x 6720
Minimum tensile strength at 2% strain, lb/ft	D6637	--	4704 x 4704	4704 x 4704
Tensile strength at 3% strain, lb/ft	D6637	825 x 825	6720 x 6720	6720 x 6720
Melting point (geogrid), deg F	D276	490	430	430
Softening point (geotextile), deg F	–	220	--	--
Softening point (tack film), deg F	--	--	--	285
Adhesive Backing	--	--	Pressure Sensitive	Pressure Sensitive

2.5 **CLAMPS, TAPE, RUBBER PADS**

A. Recommended by Supplier.

2.6 **TACK COAT**

A. Recommended by geocomposite Supplier.

2.7 **SOURCE QUALITY CONTROL**

A. Sample geogrids and geocomposites using ASTM D4354 standard practices.

B. Verify specification conformance, ASTM D4759.

PART 3 EXECUTION

3.1 **PREPARATION**

A. Instruct workers about protecting product of this Section.

B. Repair damage to subgrade surface before installation.

C. Round edges of excavation and grade changes.

3.2 **GEOGRID REINFORCEMENT FOR GRANULAR BASE**

A. Deploy each geogrid panel per manufacturer's recommendations.

B. Install panels so overlapping panel is upgrade of the underlying panel. Ties or stakes can be used to maintain overlaps. Overlap as follows.

Soil CBR Rating	**Recommended Overlap**
2 +	1.0 foot
1 – 2	2.0 feet
less than 1	3.0 feet

C. Do not bend or fold panels past 90 degrees without a minimum of 6 inches of material between bent or folded layers.

D. At least six (6) inches of fill cover is required if tracked vehicles are operated over geogrid.

E. Wheeled traffic may operate over polypropylene products if subgrade supports equipment without deforming. Repair any damage.

3.3 GEOGRID REINFORCEMENT FOR ROADWAY PAVEMENTS

A. Preparation:

1. Clean surface of bituminous concrete base course.
2. Seal cracks wider than 1/8 inch, Section 32 01 17. Repair larger cracks, potholes, depressions, and irregularities.
3. Place bituminous concrete leveling course if required.

B. Spray on tack coat uniformly at 0.08 - 010 gal-yd^2.

C. Place geogrid per manufactures recommendations.

D. Overlap geogrid in a shingle fashion on tack coat in the direction of overlay placement. Overlap geogrid edges and ends six (6) inches minimum, unless required otherwise by Supplier.

3.4 SOIL REINFORCEMENT

A. Compact embankment subgrade.

B. Place geogrids or geocomposites in embankments at the locations and elevations shown on the plans or as recommended by Supplier.

C. Do not bend or fold panels past 90 degrees without a minimum of 6 inches of material between bent or folded layers.

D. Unless specified elsewhere, compact the fill to 95 percent or greater relative to a modified proctor density.

END OF SECTION

SECTION 31 11 00
SITE CLEARING

PART 1 GENERAL

1.1 **SECTION INCLUDES**

A. Removal of trees, stumps, roots, and tree debris.

B. Clearing site of plant life, root systems and shrubs.

C. Removal of fences, fence posts, mail box posts, and miscellany.

1.2 **REFERENCES**

A. **NAA Standards**:

Pruning Standards for Shade Trees.

B. **Utah Shade Tree Pruning Standards**.

1.3 **QUALITY ASSURANCE**

A. Provide at least one person, who is familiar with NAA pruning standards for the type of tree involved, to be present during tree pruning operations.

1.4 **SITE CONDITIONS**

A. Repair or replace damaged trees and shrubs at no additional cost to OWNER.

1.5 **PROTECTION**

A. Protect roots and branches of trees to remain.

B. Construct temporary barricading at tree's approximated drip line. Place continuous barricades at least three (3) feet high.

C. When setting posts, avoid damaging tree roots.

D. Do not permit heavy equipment or stockpiling of materials or debris within the barricaded area, or permit earth surface to be changed.

E. Provide water and fertilizer to maintain existing trees.

PART 2 PRODUCTS

2.1 **STUMP TREATMENT SOLUTION**

A. Formulated to kill existing vegetation.

PART 3 EXECUTION

3.1 EXAMINATION

A. The drawings do not purport to show all trees and shrubs existing on site.

B. Verify with ENGINEER which plantings are to be removed or to remain.

C. Tree root inspection:

1. Assist ENGINEER by removing and replacing existing surface improvements.
2. Cost of removals and replacements will be paid for using existing payment prices, or if none, then by using contract Modification prices.

3.2 PREPARATION

A. Locate utilities. Preserve utilities that are to remain in service, Section 31 23 16.

B. Review work procedures with ENGINEER.

C. Schedule work carefully with consideration for property owners and general public.

D. Before starting, arrange for disconnection of all utility services that are to be removed or which interfere with work.

3.3 SITE CLEARING

A. Remove all vegetation outside of excavation, fill slope lines, and limits of slope rounding.

B. Remove fences, posts, appurtenances, and miscellaneous objects.

3.4 TREE REMOVAL

A. Remove branches, limbs, and debris.

B. Remove stumps and roots to 18 inches below proposed grade.

C. For stumps larger than six (6) inches caliper remove and treat as follows:

1. Remove chips and debris from around remaining stump.
2. Apply stump treatment solution in accordance with manufacturer's recommendations.
3. Do not allow chemical solution to mist, drip, drift, or splash onto adjacent ground surfaces or desirable vegetation.
4. Replace any existing vegetation damaged or killed through improper use of chemical at no additional cost to OWNER.

END OF SECTION

SECTION 31 23 16
EXCAVATION

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Excavation and disposal of excavated materials.

B. Protection of existing facilities such as utilities, vegetation, structures affected by excavation, etc.

1.2 PAYMENT PROCEDURES

A. No Contract Time extension shall be granted and no additional compensation shall be made if buried utilities or structures that conflict with the Work have not been found by Keyholing.

B. Perform Incidental Excavation at no additional cost to OWNER.

1.3 DEFINITIONS

A. **Authorized Over Excavation**: Upper limit of excavation is proposed excavation limit. Lower and lateral limits are as authorized by ENGINEER.

B. **Classified Excavation**: The excavation of specified materials.

C. **Incidental Excavation**: Excavation done for CONTRACTOR's benefit, excavation error, dewatering of excavation, slough, or over-break.

D. **Unclassified Excavation**: The excavation of all materials encountered regardless of the nature, size, or manner in which they are removed. Presence of isolated boulders or rock fragments will not be sufficient cause to change classification of surrounding materials.

E. **Keyholing**: The process of making a small, precisely controlled hole for “day-lighting”, or uncovering and exposing underground utilities, in order to locate or inspect them.

1.4 STORAGE AND HANDLING

A. Stockpile excavated material to cause minimum inconvenience to public and provide for emergency services as necessary.

B. Provide free access to existing fire hydrants, water valves, gas valves, and meters.

C. Provide free flow of storm water in all gutters, conduits, and natural water courses.

D. Utilize traffic control signs, markers, and procedures in product storage and handling activities.

E. Promptly remove other material from site.

PART 2 PRODUCTS

2.1 BACKFILL MATERIALS

A. Common fill, Section 31 05 13.

B. Aggregate base course, Section 32 11 23.

C. Stabilization fill, aggregate base course or common fill with maximum rectilinear particle size of two (2) inches.

D. Stabilization fabric, Section 31 05 19.

PART 3 EXECUTION

3.1 PREPARATION

A. Photograph existing surfaces where work will take place to document conditions before excavation, Section 01 78 39.

B. Use white paint and mark the proposed excavation.

C. Call the one-call center and wait the required amount of time. Colors of one call center marks indicate the following:

White	Proposed excavation
Red	Electric power lines, cables, conduit and lighting cables
Yellow	Gas, oil, steam, petroleum or gaseous materials.
Orange	Communications, alarm, signal, cables or conduits.
Blue	Potable water.
Purple	Reclaimed water, irrigation and slurry lines.
Green	Sewer and storm drain lines.
Pink	Temporary survey markings.

D. Implement traffic control plan requirements, Section 01 55 26.

E. For temporary controls, refer to Section 01 57 00.

3.2 PROTECTION

A. Identify required lines, grades, contours, and benchmarks, Section 01 71 23.

B. Utilities:

1. Keyhole, expose or otherwise locate utilities as necessary to give utility agency at least one (1) day notice to protect, preserve, or relocate a utility that may interfere with or may be damaged by excavation work. Perserve utilities that remain in service.

2. Where utilities or structures conflict with design grades, report conflict to appropriate utility company and ENGINEER 14 days before initiating work within the conflict area.

C. Support and protect from damage any existing facility and structure that

exists in, passes through, or passes under the site.

D. Protect existing landscape sprinkler systems. When sprinkler system disturbance is required, interrupt and repair system so operation of system is maintained, Section 02 41 13.

E. Carefully remove soil around tree roots so ENGINEER can assess stability and health of tree.

3.3 **GENERAL EXCAVATION REQUIREMENTS**

A. Excavate topsoil from areas to be relandscaped or regraded and other marked areas.

B. Excavate site to line and grade indicated. Legally dispose of excavated material.

C. Carefully excavate soils in vicinity of buried utility marks placed by the one-call center.

D. Where soil has been softened or eroded by flooding or hardened by drying, rework all damaged areas or replace with approved material at no additional cost to OWNER.

E. Notify ENGINEER of unexpected subsurface conditions.

F. Underpin adjacent structure, service utilities and pipe chases that may be damaged by excavation work.

G. Protect excavation walls as required. If conditions permit, slope excavation sides to maintain a safe and clean working area. Remove loose materials.

H. Where ENGINEER deems subgrade material to be susceptible to frost heave or otherwise unsatisfactory, excavate additional depth.

3.4 **TOPSOIL**

A. Excavate topsoil only to depth that will preserve topsoil quality.

B. Do not mix topsoil with subsoil during stockpiling or spreading.

3.5 **SHORING**

A. Slope, shore, sheet, brace or otherwise support excavations over four (4) feet deep, Section 31 41 00.

B. When soil conditions are unstable, excavations shallower than four (4) feet deep must also be sloped, supported or shored.

3.6 **DEWATERING**

A. Keep excavation free from surface and ground water.

B. If ground water is in the intended construction operations, dewater excavations.

C. If there are no olfactory or visual indications of contamination in the water, discharge according to requirements of Federal, State or local agency having jurisdiction.

D. If any evidence of contamination in the water, based on olfactory or visual indications, cease excavation work until potential risks are evaluated. During evaluation, handle water as a contaminated material.

E. Pay for damages and costs resulting from dewatering operations.

3.7 ROADWAY EXCAVATION

A. In advance of setting line and grade stakes, clear and grub area of brush, weeds, vegetation, grass, and debris. Drain all depressions or ruts.

B. Roadway excavation is Unclassified Excavation. It includes Portland cement concrete or bituminous concrete pavement removal and removal of any aggregate base or sub-base material to line and grade established by Drawings or ENGINEER.

3.8 STRUCTURAL AND LANDSCAPE EXCAVATION

A. Provide shoring, cribs, cofferdams, caissons, pumping, bailing, draining, sheathing, bracing, and related items.

B. For piling work, coordinate special requirements for piling. Protect excavation walls.

C. If conditions permit, slope excavation sides as excavation progress. Maintain a safe and clean working area.

D. Support excavations. Do not interfere with the bearing of adjacent foundations, pipelines, etc.

3.9 TRENCH EXCAVATION

A. Grade bottom of trenches to provide uniform bearing surface.

B. If necessary, make bell holes and depressions required for laying and joining pipe or box.

C. Limit width of trench excavations to the dimensions suitable for worker access per pipe manufacturer's recommendation. Provide enough space for compaction equipment. Notify ENGINEER if excavation operations exceed any indicated line and grade limits.

D. In roadways and regardless of trench depth, limit length of open trenches to 200 lineal feet day or night. Provide barricading, Section 01 55 26. Protect trenches over night.

3.10 STABILIZATION EXCAVATION

A. Perform stabilization excavation as Incidental Excavation.

3.11 AUTHORIZED OVER EXCAVATION

A. Over excavation must be permited by ENGINEER to be classified as authorized over excavation. Volume will be determined by the method of average-end-areas in the original position.

3.12 TOLERANCE

A. Grading: Top surface of Subgrade = plus or minus 1 inch.

END OF SECTION

SECTION 31 23 23
BACKFILLING FOR STRUCTURES

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Structural backfill materials.

B. Structural backfilling requirements.

1.2 REFERENCES

A. **ASTM Standards**:

D698 Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft-lbf/ft^3 (600 kN-m/m^3)).

D1557 Standard Test Methods for Laboratory Compaction Characteristics of Soil using Modified Effort (56,000 ft-lbf/ft^3 (2,700 kN-m/m^3)).

D2922 Density of Soil and Soil-Aggregate in Place by Nuclear Methods (Shallow Depth).

D4832 Preparation and Testing of Soil-Cement Slurry Test Cylinders.

1.3 SUBMITTALS

A. Submit maximum laboratory dry density and optimum laboratory moisture content for:

1. Subgrade material, and
2. Each type of fill to be used.

1.4 QUALITY ASSURANCE

A. Do not change material sources, or aggregate without ENGINEER's knowledge.

B. Reject backfill material that does not comply with requirements specified in this Section.

C. If requested, submit a written quality control inspections and testing report describing source and field quality control activities performed by CONTRACTOR and Suppliers.

1.5 STORAGE

A. Safely stockpile backfill materials.

B. Separate differing materials, prevent mixing, and maintain optimum moisture content of backfill materials.

1.6 SITE CONDITIONS

A. Do not place, spread, or roll any backfill material over material that is damaged by water. Remove and replace damaged material at no additional cost to OWNER.

B. Control erosion. Keep area free of trash and debris. Repair settled, eroded, and rutted areas.

C. Reshape and compact damaged structural section to required density.

1.7 ACCEPTANCE

A. **General**: Native material may be wasted if there is no additional cost to substitute material acceptable to ENGINEER.

B. **Material**: For material acceptance refer to:

1. Common fill, Section 31 05 13.
2. Aggregate base course, Section 32 11 23.
3. Cement treated fill, Section 31 05 15.

C. **Lift thickness**: One test per Lot.

D. **Compaction**: One test per Lot. Verify compaction using nuclear tests, ASTM D2922. Density and lot sizes as follows:

Table 1 – Density and Lot Sizes

Structure Type	Density	Proctor	Lot Size
Strip Footings	95	Standard	Subgrade: 200 linear feet
	98	Modified	Aggregate base course: 200 linear feet per lift.
Structure Footing excluding strip footings	95	Standard	Subgrade: 225 square feet.
	98	Modified	Aggregate base course: Each 225 square feet per lift
Embankments	95	Standard	Fill: 625 square feet per lift
Interior Slab on Grade	98	Modified	Aggregate base course: 625 square feet
Side of Foundation Walls and Retaining Walls	95	Standard	Exterior:
	98	Modified	Interior
Miscellaneous small structures (e.g. Manholes, drainage boxes, etc.)	95	Standard	Subgrade: Each footprint area Fill: Each lift
	98	Modified	Aggregate base course: Each lift

NOTES
(a) Standard proctor, ASTM D698.
(b) Modified proctor, ASTM D1557.

E. **Flowable Fill Strength**: Lot size is one day production with sub-lots of 250 cubic yards or part thereof. Verify strength using cylinders, ASTM D4832.

F. **Grade, Cross Slope**: Measured at random locations.

1.8 **WARRANTY**

A. Repair settlement damage at no additional cost to OWNER.

PART 2 PRODUCTS

2.1 **BACKFILL MATERIALS**

A. Common fill, Section 31 05 13. Granular material, CONTRACTOR's choice.

B. Aggregate base course, Section 32 11 23. Untreated base course.

C. Cement treated fill, Section 31 05 15. Use a flowable fill so vibration is not required.

2.2 **WATER**

A. Make arrangements for sources of water during construction and make arrangements for delivery of water to site.

B. Comply with local Laws and Regulations at no additional cost to OWNER when securing water from water utility company.

PART 3 EXECUTION

3.1 **PREPARATION**

A. Implement traffic control plan requirements, Section 01 55 26.

B. Verify:

1. Backfill material meets gradation requirements.
2. Foundation walls are braced to support surcharge forces imposed by backfilling operations, areas to be backfilled are free of debris, snow, ice or water.
3. Ground surface is not frozen.

C If ground water is in the intended backfill zone, dewater.

3.2 **PROTECTION**

A. Protect existing trees, shrubs, lawns, structures, fences, roads, sidewalks, pavings, curb and gutter and other features.

B. Protect above or below grade utilities. Contact utility companies to repair utility damage. Pay all cost of repairs.

C. Avoid displacement of and damage to existing installations while compacting or operating equipment. Do not fill adjacent to structures until excavation is checked by ENGINEER.

D. Do not use compaction equipment adjacent to walls or retaining walls that may cause wall to become over-stressed or moved from alignment.

E. Do not disturb or damage foundation perimeter drainage, foundation, damp-proofing, foundation waterproofing and protective cover, or utilities in trenches. Movement of construction machinery over work at any stage of construction is solely at CONTRACTOR's risk.

F. Restore any damaged structure to its original strength and condition.

3.3 LAYOUT

A. Identify required line, levels, contours, and datum.

B. Stake and flag locations of underground utilities.

C. Upon discovery of unknown utility or concealed conditions, notify ENGINEER.

D. Maintain all benchmarks, control monuments and stakes, whether newly established by surveyor or previously existing. Protect from damage and dislocation.

E. If discrepancy is found between Contract Documents and site, ENGINEER shall make such minor adjustments in the Work as necessary to accomplish the intent of Contract Documents without increasing the Cost of the Work to CONTRACTOR or OWNER.

3.4 SUBGRADE

A. Protect Subgrade from desiccation, flooding, and freezing.

B. Before backfilling over Subgrade, get ENGINEER's inspection of subgrade surface preparations.

C. If Subgrade is not readily compactable get ENGINEER’s permission to stabilize the subgrade.

3.5 FOUNDATIONS AND SLABS ON GRADE

A. Lift thickness before compaction is eight (8) inches.

B. Do not backfill against walls until concrete has obtained 14 days strength. Backfill against foundation walls simultaneously on each side.

C. Fill unauthorized excavations with material acceptable to ENGINEER at no additional cost to OWNER.

D. Do not damage adjacent structures or service lines.

E. Where flowable fill is used, use fill that flows easily and vibration for compaction is not required.

3.6 MODIFIED BACKFILL LAYER METHOD

A. Section 33 05 20.

3.7 TOLERANCES

A. Compaction: Ninety-five (95) percent or ninety eight (98) percent minimum relative to a standard or modified proctor density, Section 31 23 26.

B. Lift Thickness (before compaction):

1. Eight (8) inches when using riding compaction equipment.
2. Six (6) inches when using hand held compaction equipment.
3. As proven in the modified backfill layer method, Section 33 05 20.

C. Cement Treated Fill: Compressive strength targets are 60 psi in 28 days and 90 psi maximum in 28 days.

3.8 CLEANING

A. Remove stockpiles from site. Grade site surface to prevent free standing surface water.

B. Leave borrow areas clean and neat.

END OF SECTION

SECTION 31 23 26
COMPACTION

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Compaction of granular fill materials.

1.2 REFERENCES

A. **ASTM Standards**:

D698 Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft-lbf/ft^3 (600 kN-m/m^3)).

D1557 Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000 ft-lbf/ft^3 (2,700 kN-m/m^3))

D2216 Laboratory Determination of Water (Moisture) Content of Soil and Rock.

D2922 Density of Soil and Soil-Aggregate in Place by Nuclear Methods (Shallow Depth).

D3017 Water Content of Soil and Rock in Place by Nuclear Methods (Shallow Depth).

D3282 Classification of Soils and Soil-Aggregate Mixtures for Highway Construction Purposes.

D3740 Minimum Requirements for Agencies Engaged in the Testing and/or Inspection of Soil and Rock as Used in Engineering Design and Construction.

1.3 DEFINITIONS

A. **A-1 Soil**: Defined in ASTM D3282.

B. **Modified Proctor Density**: The maximum laboratory density, as defined in and determined by ASTM D1557 using procedure A, B or C as applicable.

C. **Relative Density (or Relative Compaction):** The ratio of field dry density to the maximum laboratory density expressed as a percentage.

D. **Standard Proctor Density**: The maximum laboratory density, as defined in and determined by ASTM D698 using procedure A, B or C as applicable.

1.4 QUALITY ASSURANCE

A. Use a soil and rock laboratory that complies with ASTM D3740.

PART 2 PRODUCTS Not Used

PART 3 EXECUTION

3.1 COMPACTION

A. Moisten or dewater backfill material to obtain optimum moisture for compaction.

B. When no density compactive effort is specified, compact the entire area to 95 percent and eliminate unstable zones.

C. Correct deficient compaction conditions. Replace or repair materials and damaged facilities.

3.2 FIELD QUALITY CONTROL

A. **Testing**: Perform control testing of materials. Perform additional testing at no additional cost to OWNER, for

1. Changes in source of materials or proportions requested by CONTRACTOR, or
2. Failure of materials to meet specification requirements, or
3. Other testing services needed or required by CONTRACTOR.

B. **Optimum Soil Density**: Use ASTM D2216 and the following industry standards.

1. For A-1 Soils: Method C of ASTM D1557 (Modified Proctor)
2. For All Other Soils: Method C of ASTM D698 (Standard Proctor).

C. **Field Density**:

1. Use ASTM D3017 and test method C of ASTM D2922 for shallow depth nuclear testing.
2. No density determinations are required on any material containing more than 65 percent material retained on the number 10 sieve or more than 60 percent material retained on the number 4 sieve. In lieu of reporting densities in such cases, report the sieve analysis to document the material type.

3.3 REPORT

A. For each material tested, document the following:

1. Vertical and horizontal location of the test.
2. Optimum laboratory moisture content.
3. Field moisture content.
4. Maximum laboratory dry density.
5. Field density.
6. Percent compaction results.
7. Certification of test results by Independent Testing Agency.

END OF SECTION

SECTION 31 25 00
EROSION AND SEDIMENTATION CONTROL

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Erosion control and slope protection facilities including blankets or mulches.

B. Construction of drainage facilities to protect work area.

1.2 SUBMITTALS

A. Submit before using:

1. Sample of blanket or geotextile materials.
2. Mulch formula.
3. Grass mixture listing.
4. Plant list.
5. Geotextile manufacturer's certification.

B. Application rate of fiber mulches recommended by tackifier manufacturer.

1.3 DELIVERY, STORAGE AND HANDLING

A. Deliver seed in original containers with certified germination test results showing analysis of seed mixture, percentage of pure seed, year of production, and date of packaging. Damaged packages are not acceptable. Store seed free of moisture.

B. Deliver fertilizer in waterproof bags showing weight, chemical composition and name of manufacturer.

C. Deliver blanket in original wrapping showing name of manufacturer and product weight.

D. Deliver plant materials immediately before placement.

E. Replace plant when original root protection system (burlap bag wrap of earth ball, plastic container with special plant bedder, etc.) has been broken or displaced before planting.

PART 2 PRODUCTS

2.1 MATERIALS

A. Riprap: Rock, Section 31 37 00.

B. Blankets: Uniform open weave jute, wood fiber, biodegradable or photodegradable synthetic fiber matting.

C. Geotextiles: Section 31 05 19.

D. Erosion Control Vegetation Mats: Permanent three dimensional mats that allow for revegetation where high water flows are expected.

E. Fiber Mulches: Straw, hay, wood or paper free from weeds and foreign matter detrimental to plant life.

F. Mulch Binder: Vegetable based gel tackifier with growth stimulant.

G. Topsoil and Fertilizer: Section 31 05 13 and Section 32 92 00.

PART 3 EXECUTION

3.1 PREPARATION

A. Remove foreign materials, roots, rocks, debris.

B. Grade to eliminate rough spots, ponding areas.

C. Grade soil to drain perimeter water away from protected areas.

D. Temporary controls, Section 01 57 00 as applicable.

3.2 SLOPE PROTECTION BLANKET

A. Cover seeded slopes where grade is greater than one (1) vertical to three (3) horizontal with blanket. Roll down over slopes carefully and loosely without stretching or pulling.

B. Lay blanket smoothly on prepared soil surface. Bury top end of each section in a narrow trench. Leave 24 inches overlap from top roll over bottom roll. Leave 12 inches overlap over adjacent section.

C. Toe-wrap fabric at bottom of slope.

D. Staple loosely the outside edges and overlaps.

E. In ditches, lay matting in upstream direction. Overlap and staple ends six (6) inches with upstream section on top.

F. If natural drainage water traverses protected or controlled area; construct a channel or riprap Section 31 37 00.

G. Lightly dress slopes with topsoil to ensure close contact between cover and soil.

H. Present alternative methods of protection for approval before starting any work.

3.3 GEOTEXTILE

A. Placement, Section 31 05 19.

3.4 MULCHES

A. Apply mulches at the rate necessary.

B. When installed with a tackifier, apply at the rate recommended by the tackifier supplier.

3.5 SURFACE COVER

A. Grass, Section 32 92 00.

B. Ground cover, Section 32 93 13.

3.6 **MAINTENANCE**

A. Maintain surfaces and supply additional topsoil where necessary, including areas affected by erosion.

B. Protect and repair geotextiles, Section 31 05 19.

C. Keep surface of soil damp only as necessary for seed germination.

D. Apply water slowly so surface of soil will not puddle and crust.

E. Replant damaged grass areas showing root growth failure, deterioration, bare or thin spots, and eroded areas.

F. Re-fertilize 60 days after planting.

G. Remove weeds that are over three (3) inches high.

END OF SECTION

SECTION 31 31 19
VEGETATION CONTROL

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Application of soil treatment to remove weed and vegetation.

1.2 SUBMITTALS

A. Submit certificate identifying composition of non-selective control herbicide.

PART 2 PRODUCTS

2.1 HERBICIDE

A. Water soluble herbicide for non-selective control of annual and perennial weeds.

PART 3 EXECUTION

3.1 MIXING

A. Mix herbicide solution in strict accordance with manufacturer's instructions and applicable Laws and Regulations.

3.2 APPLICATION

A. Execute all work in an orderly and careful manner with due consideration for surrounding plantings that are to remain.

B. Apply herbicide solution with a shield applicator. Do not allow solution to mist, drip, drift, or splash onto desirable vegetation.

C. Apply solution according to manufacturer's recommendations seven (7) days before preparation of surface to receive additional cover material. Do not add cover material until ENGINEER reviews spraying results.

D. Do not spray under windy or adverse weather conditions.

E. Replace portions of surrounding vegetation damaged or killed through this operation.

END OF SECTION

SECTION 31 37 00
RIPRAP OR ROCK LINING

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Placement of loose riprap, hand-placed riprap, or grouted riprap.

1.2 REFERENCES

A. **ASTM Standards**:

C535 Resistance to Degradation of Large-Size Coarse Aggregate by Abrasion and Impact in the Los Angeles Machine.

1.3 SUBMITTALS

A. Submit before use in the Work product data showing riprap source, gradation, aggregate wear and placement technique.

PART 2 PRODUCTS

2.1 AGGREGATE

A. Durable, angular, hard stone free from seams and cracks.

B. Graded in size to produce a reasonably dense mass.

C. The greatest dimension of 25 percent of the stones shall be at least, equal to but not more than 1-1/2 times the thickness of riprap indicated.

D. The greatest dimension of 50 percent of the stone shall be at least 3/4, but not more than 1-1/2 times the thickness of riprap indicated.

E. Not more than 10 percent of the aggregate shall have a dimension less than 0.1 times the thickness of riprap.

F. At least 95 percent of the stones shall have at least two (2) fractured or clean angular faces.

2.2 ACCESSORIES

A. Portland cement grout, Section 03 61 00.

B. Geotextile fabric, Section 31 05 19.

C. Grout, Section 04 05 16.

2.3 SOURCE QUALITY CONTROL

A. Aggregate: Wear not greater than 40 percent when tested, ASTM C535.

PART 3 EXECUTION

3.1 PREPARATION

A. Remove all brush, trees, stumps, and other objectionable materials and dress area to a smooth surface. Make Excavation to provide a firm foundation and protect against undercutting. Secure approval before backfilling.

B. Install required geotextile in accordance with Section 31 05 19.

3.2 LOOSE-PLACED RIPRAP

A. Place stones to secure a Rock mass with the minimum thickness and height indicated. Manipulate Rock to secure a regular surface of graded size and mass stability.

3.3 HAND-PLACED RIPRAP

A. Place and bed rocks, one against the other, and key together. Fill irregularities between stones with suitable size spalls.

B. Place so finished surface of riprap is even, tight, and true to line and grade. Extend riprap sufficiently below ground surface to secure a firm foundation.

3.4 GROUTED RIPRAP

A. After placement and wetting the stones, sweep sand or fine gravel into the interstices to fill to within four (4) inches of the outer surface of the riprap.

C. Fill the remaining volume of the interstices flush with a well-mixed grout.

D. Keep grout wet by sprinkling or covering with wet material for at least three (3) days. Protect grout from stream water or any other disturbance during this cure period.

E. Do not place grout in freezing weather.

END OF SECTION

DIVISION 32

EXTERIOR IMPROVEMENTS

SECTION 32 01 05
INFORMATION, REGULATORY, AND WARNING SIGNS

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Information, regulatory, and warning signs but not street name signs or construction signs.

1.2 REFERENCES

A. **ASTM Standards**:

B209: Aluminum and Aluminum - Alloy Sheet and Plate.

B. **FS Standards**:

L-P 380: Plastic Molding Material Methacrylate.

L-S-300: Sheeting and Tape, Reflective: Nonexposed Lens.

C. **National Bureau of Standards**:

PS 1: Construction and Industrial Plywood.

D. **DOT Standards**:

MUTCD: Manual on Uniform Traffic Control Devices for Streets and Highways.

1.3 DEFINITIONS

A. For definition purposes, the various types of signs are identified by a combination of letter and number. The letter represents the type of sign panel construction and the number represents the type of lettering and symbols to be used as follows:

1. Panel Type:
   a. Type A: Reflectorized sheeting on sheet aluminum.
   b. Type B: Reflectorized sheeting on plywood.
2. Letter Type:
   a. Type 1: Reflectorized demountable cutout letters, symbols, and borders with prismatic reflectors.
   b. Type 2: Opaque legend and borders.
   c. Type 3: Reflectorized permanently attached cutout letters, symbols, and borders or reflectorized screen processed letters, symbols, and borders.

1.4 SUBMITTALS

A. Submit Shop Drawings of support structures before fabrication.

B. Submit sample of each color of reflective sheeting including manufacturer's name and product number.

PART 2 PRODUCTS

2.1 MATERIALS

A. Sign Blank:

1. Aluminum Sheet: 0.1 inch thick ASTM B209 alloy 6061-T6.
2. Aluminum Extrusion: 0.1 inch thick ASTM B209 alloy 6063-T5 and 6063-T6.
3. Softwood Plywood: PS 1 Group 1 with each panel bearing initials DFPA Grade - Trademark of the American Plywood Association; painted to ENGINEER's choice of color unless indicated.

B. Posts: Galvanized structural steel, U-shaped, T-shaped, C-shaped, box-shaped, or round tube, Section 05 12 00, with 3/8 inch diameter mounting holes.

C. Fabricated Supports: Galvanized steel, Sections 05 05 10 and 05 12 00.

D. Sheeting:

1. Reflective: FS L-S-300 with 2,200 hours minimum durability.
2. Nonreflective: Nonchalking, weather resistant transparent plastic having a protected adhesive backing and a smooth flat outer surface with glass spheres embedded within.

E. Prismatic Reflectors: Methyl methacrylate lens meeting FS L-P-380 requirements with aluminum frame.

F. Bolts, Nuts, Accessories: Galvanized steel, Section 05 05 23.

G. Cast-in-place Concrete: Class 3000 minimum, Section 03 30 04.

2.2 COLORS AND FORMAT

A. Sign Colors and Format: MUTCD.

B. Provided colors of same reflectorized hue in daylight and night under artificial white illumination.

PART 3 EXECUTION

3.1 PREPARATION

A. Locate and preserve utilities, Section 31 23 16.

B. Excavation, Section 31 23 16.

3.2 INSTALLATION

A. Do not remove a sign that is being replaced until the new sign is placed and uncovered. Provide temporary covering. Maintain covering until removal.

B. Unless indicated otherwise use clearance and locations shown in MUTCD. Install posts plumb and in proper alignment. Construct sign

post foundations with concrete. Finish foundations flush with or below natural ground.

C. Establish proper elevation and orientation of all signs, structures, and determine proper sign post lengths as dictated by construction slopes.

D. Construct overhead support structures where indicated with signs horizontal and perpendicular to roadway. Minimum allowable vertical clearance from high point of pavement is 16.5 feet.

3.3 **WORKMANSHIP**

A. Carefully fabricate and erect signs. Damage signs will be rejected.

B. Make all vertical joints and cuts flat and true.

C. Elevator bolts may be used or bolt holes relocated where conflict exists with sign border, legend, or copy.

D. Lay out and properly balance on the sign face all Type 1 legend and copy before fastening. Plug holes left by shifting of copy or legend with the same type screw used to fasten the legend.

E. Wash all sign faces before final inspection, Section 01 74 13.

END OF SECTION

SECTION 32 01 06
STREET NAME SIGNS

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Requirements for street name sign and components.

1.2 REFERENCES

A. **ASTM Standards**:

B 209 Aluminum and Aluminum-Alloy Sheet and Plate.

B. **FS Standards**:

L-S-300 Sheeting and Tape, Reflective: Nonexposed Lens.

PART 2 PRODUCTS

2.1 MATERIALS

A. Blanks:

1. Aluminum Sheet: 0.1 inch thick ASTM B209 alloy 6061-T6, of the height indicated with length required to spell the street name (18, 24, 30, 36, 42, 48 inches).
2. Nonmetallic: Fiberglass reinforced composite bonded with a thermosetting polymer and the following properties:
   a. Tensile strength (transverse), 5,000 psi minimum.
   b. Tensile strength (longitudinal), 25,000 psi minimum.
   c. Lengths as required to spell the street name (18, 24, 30, 36, 42, 48 inches).
   d. Height as indicated.

B. Reflective Sheeting: Reflective per FS L-S-300 with 2,200 hours minimum durability.

C. Sign Lettering: White upper case and lower case letters, reverse silk screened on white with specified background color transparent ink.

D. Letter Composition: Spell out street name and give numerical coordinate on the right hand side; include neighborhood logo, if applicable, on the left hand side. Font as indicated.

E. Rail for Sign Blank: Tensile strength 40,000 psi minimum.

F. Posts: Galvanized structural steel, U-shaped, T-shaped, C-shaped, box-shaped, or round tube per Sections 05 12 00 and Section 05 05 10 requirements, with 3/8 inch diameter mounting holes.

G. Bolts, Nuts, Accessories: Galvanized steel, Section 05 05 23.

H. Cast-in-place Concrete: Class 3000 minimum,Section 03 30 04.

PART 3 EXECUTION

3.1 PREPARATION

A. Locate and preserve utilities, Section 31 23 16.

B. Excavation, Section 31 23 16.

3.2 INSTALLATION

A. Set posts two (2) feet deep and anchored in concrete.

B. Provide 10 feet high clearance from the ground level to the bottom of sign.

C. Install posts plumb so closest edge of sign is two (2) feet from vertical projection of the curb face at the point of curve (PC) of the intersection approach curb.

D. Restore all surfaces damaged during installation.

END OF SECTION

SECTION 32 01 07
RELOCATE POST MOUNTED SIGNS AND MAIL BOXES

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Relocate post mounted signs.

B. Relocate mail boxes to supports approved by USPS.

1.2 REFERENCES

A. **USPS Standards**:

Mailbox requirements.

1.3 DEFINITIONS

A. **Post Mounted Signs**: Street name signs and traffic control signs such as regulatory signs, warning signs, guide signs, detour and closure signs.

PART 2 PRODUCTS

2.1 CONCRETE

A. Cast-in-place: Class 3000 minimum, Section 03 30 04.

2.2 MAIL BOX SUPPORTS

A. Wood: Salt treated fir, hemlock or pine for post, shelf and brace. Grade: No. 2 or better.

B. Metal: Galvanized or dark epoxy painted steel post, shelf and brace with no defects.

PART 3 EXECUTION

3.1 PREPARATION

A. Locate and preserve utilities, Section 31 23 16.

B. Excavate, Section 31 23 16.

C. Reuse existing mail boxes, street signs and posts unless indicted otherwise.

3.2 EXISTING TRAFFIC CONTROL SIGNAGE

A. Maintain all existing traffic control and street signs in full view of the intended traffic.

B. Coordinate post mount sign relocations such that view of existing traffic control and street signs is maximized.

3.3 SIGN RELOCATION

A. Maintain existing signs until construction requires removal. Coordinate with ENGINEER 24 hours in advance of removal of any sign.

B. Relocate existing street signs indicated or ordered by ENGINEER.

C. Remove concrete from existing posts where posts are to be reused.

D. Protect new signs and posts until Project is accepted.

E. Reset post in concrete, eight (8) inches in diameter to depth indicated or ordered by ENGINEER.

F. Completely fill and compact hole left by removing sign post. Match adjacent surface.

3.4 MAIL BOX RELOCATION

A. Completely remove all designated mail box posts and footings.

B. Furnish and install new posts, shelf, and brace.

C. Relocate existing mail boxes indicated or ordered by ENGINEER.

D. Attach box firmly to shelf and post.

E. Repair any damage done to mail box during moving or replace if irreparable to ENGINEER's and mail box owner's satisfaction.

F. Compact soil around post and provide firm support.

G. Provide support for temporary mail box as required during construction at no extra cost to OWNER, with temporary mail box located in accordance with United States Postal Service requirements.

H. Restore original location of box to condition equivalent to adjacent area.

3.5 PAVEMENT MARKINGS

A. Section 32 17 23.

END OF SECTION

SECTION 32 01 10
RELOCATE FENCES AND GATES

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Reset existing fences and gates in new locations.

PART 2 PRODUCTS

2.1 MATERIALS

A. Nails, Spikes and Staples: Galvanized steel for exterior, high humidity locations, and treated wood. Size and type to suit applications.

B. Chain Link Fences and Gates: Section 32 31 13.

C. Wire Fences and Gates: Section 32 31 16.

D. Concrete: Class 3000 minimum, Section 03 30 04.

PART 3 EXECUTION

3.1 PREPARATION

A. Coordinate locating utilities, Section 01 31 13.

B. Excavation, Section 31 23 16.

3.2 INSTALLATION

A. Completely remove all existing posts, footings, wires, gates, and other items used in fencing.

B. Remove concrete on posts. Reuse posts, wire, and gates from existing fence.

C. Replace any fencing materials and gates that are damaged, lost, or broken during fence and gate relocations. Provide new materials as required which meets Specifications, for fence and gates of the same type.

D. Set relocated fences and gates straight and true.

E. Fill in old post holes unless they become part of new construction.

F. Reset posts in concrete, eight (8) inches in diameter to depth indicated or two (2) feet minimum.

END OF SECTION

SECTION 32 01 16.71
COLD MILLING BITUMINOUS PAVEMENT

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Lower surface elevation of bituminous concrete Pavement by milling.

B. If grinding is required to smouth-out surface bumps or depressions refer to Section 32 01 26.

1.2 PAYMENT PROCEDURES

A. No payment for leveling course to correct over milling or for additional milling to correct shallow milling.

1.3 REFERENCES

A. **APWA (Utah) Standards:**

Plan 253 Bituminous concrete pavement overlay.

1.4 SUBMITTALS

A. Traffic control plan, Section 01 55 26.

B. Arborist's certification.

C. Pre-milling profilographs for full width mills.

D. Redline drawings showing discovered existing utilities.

1.5 QUALITY ASSURANCE

A. Provide a person capable of calculating grades and cross-slopes in degrees and percentages. Cross slopes vary when the crown line is not parallel to pavement edge line.

1.6 SITE CONDITIONS

A. Existing Street Fixtures may have been paved over making them hidden (or buried). Locate and protect them. Failure to find them may result in damage to milling equipment. Repair damaged CONTRACTOR machinery and Street Fixtures at no cost to OWNER.

PART 2 PRODUCTS

Not Used

PART 3 EXECUTION

3.1 CONSTRUCTION EQUIPMENT

A. Detector: Able to find Street Fixtures (utility frames and covers, valve boxes, etc.) that are buried under pavement surface.

B. Milling Machine:
   1. Equipped to prevent air pollution.
   2. Equipped with a system to control depth and slope of mill cut.

C. Cleaning equipment able to pick up millings and waste water.

3.2 PREPARATION

A. Notify neighborhood at least 48 hours before day and time of milling.

B. Coordinate utility locations, Section 01 31 13. Preserve all active utilities.

C. Implement traffic control plan requirements in Section 01 55 26.

D. Mark areas in the field that are to be milled. Mark existing utilities on redline drawings.

E. Use a detector to find hidden (or buried) Street Fixtures.

3.3 PROTECTION

A. Install Invert Covers, Section 01 71 13.

B. Lower utility frames, covers, and other Street Fixtures.

C. Trees may require pruning, Section 32 01 93. Avoid or minimize damage to tree branches. Provide certified arborist observation of tree branch cuts larger than four (4) inches diameter. Notify ENGINEER of such tree branch cut or damage.

D. CONTRACTOR is liable for any property damage due to loose material on pavement surface, vertical pavement cuts, drop-offs, etc.

E. Protect plant and animal habitat. Follow federal, state or local work permit requirements.

3.4 MILLING

A. If not indicated elsewhere meet cross slopes and depth of milling shown on APWA Plan 253.

B. Meet profile grade required or indicated by ENGINEER.

C. Do not disfigure adjacent work or existing surface improvements by accidentally cutting into them. Make appropriate repairs.

D. If milling exposes smooth underlying pavement surface, mill the smooth surface to make it rough.

E. Mill off additional material if standing water has a potential to accumulate or if surface has been damaged by water since beginning of milling operation.

F. Where vehicles or pedestrians must pass over milled edges provide safe temporary ramps suitable to speed of user vehicles (or suitable for wheel chair user needs).

G. Unless stipulated elsewhere, all residues from the milling process become property and responsibility of CONTRACTOR. Waste millings legally. Do not discharge millings into storm drains, ditches, or waters of the State.

H. If work equipment is removed from the milling site and milled surface

awaits further work, provide appropriate traffic control and cleaning.

I. Notify ENGINEER when milling exposes weak or unstable surfaces. Verify extent of exposure by proof rolling at no additional cost to OWNER.

3.5 **TOLERANCES**

A. Milling Depth: As indicated plus or minus 10 percent not uniformly high or uniformly low.

B. Striation Texture: Uniform, discontinuous, longitudinal, 3/16 inch deep maximum, 3/4 inch center to center.

C. Smoothness:

1. On Longitudinal Grade: Plus or minus 5/16 inch in 25 feet.
2. At Longitudinal Grade Breaks: Plus or minus 1/4 inch in 10 feet.

D. Cross Slope:

1. In the Parking Lane: Two (2) percent target, five (5) percent maximum.
2. In the Travel Lane: Two (2) percent target, 1.5 percent minimum.

3.6 **FIELD QUALITY CONTROL**

A. Edge Mill: Verify cross slopes. Advise ENGINEER if a two (2) percent maximum break-over angle on an edge mill indicated on APWA Plan 253 cannot be achieved.

B. Full Width Mill:

1. Verify cross slopes. Advise ENGINEER if a four (4) percent maximum break-over angle on a full width mill indicated on APWA Plan 253 cannot be achieved.
2. On thoroughfares exceeding 25 mph use laser profiling to determine depth of milling along the proposed crown line or other breakover point.
3. Verify cut depth calculations with ENGINEER before milling.

3.7 **CLEANING**

A. Unless indicated elsewhere, all residues from the milling process become property and responsibility of CONTRACTOR. Waste millings legally. Do not discharge millings into storm drains, ditches, or waters of the State. Legally dispose of milled material.

END OF SECTION

SECTION 32 01 16.74

IN-PLACE HOT REUSED BITUMINOUS PAVING

PART 1 GENERAL

1.1. SECTION INCLUDES

A. Seamless repair of bituminous concrete pavement by applying evenly distributed heat over the pavement surface, then mixing and compacting the heated pavement in-place.

1.2 REFERENCES

A. **APWA (Utah) Standards:**

Plan 254 Patch repair – in place hot reused bituminous paving.

1.3 SUBMITTALS

A. Manufacturer's product data, equipment and material specifications.

B. Traffic control plan, Section 01 55 26.

1.4 PERFORMANCE REQUIREMENTS

A. Use a method that does not burn the pavement surface or burn off any existing bituminous pavement volatiles.

PART 2 PRODUCTS

2.1 MATERIAL

A. Rejuvenating agent, bituminous concrete mix, and reclaimed RAP or ROSP aggregate.

PART 3 EXECUTION

3.1 PREPARATION

A. Implement traffic control plan requirements, Section 01 55 26.

B. Mark areas in the field that are to be repaired. Mark existing utilities on redline drawings.

C. Use a detector to find hidden (or buried) Street Fixtures.

3.2 REPAIRS

A. Apply heat to areas to be repaired:

1. Do not exceed a surface temperature of 350 deg F
2. Minimum surface temperature is as indicated in Section 32 12 16.13.

B. Follow APWA Plan 254 requirements. Mechanically scarify and thoroughly mix the repair area. Provide beveled sides.

C. Add and thoroughly mix additional bituminous material and rejuvenating agent as required to fill depressions, Potholes, or to match grade of adjacent pavement surfaces.

D. Screed and level the repair area in preparation for compaction and allow the material to become integral with edges of repair area.

E. Compact surface with a steel drum roller. Match the grade of the adjacent pavement after compaction. No longitudinal surface bumps allowed.

F. Cool repaired area to 150 deg F before opening to vehicular traffic.

G. Reapply heat and rework area in the case where bumps and depressions are present in finished surface.

H. Sweep up and dispose of excess material and debris.

I. Repair any damage at no additional cost to OWNER.

END OF SECTION

SECTION 32 01 31
PAVEMENT SMOOTHNESS

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Smoothness tolerances for placing flexible pavements, rigid pavements, and pavement patches.

B. Procedure for correcting defective smoothness.

1.2 REFERENCES

A. **ASTM Standards**:

E950 Measuring the Longitudinal profile of Traveled Surfaces with an Accelerometer Established Inertial Profiling Reference.

E1274 Measuring Pavement Roughness Using a Profilograph.

1.3 DEFINITIONS

A. **Must Grind**: Areas of roadway pavement not meeting profile deviation tolerance.

B. **Road Class**: Attribute of a public or private thoroughfare based upon equivalent single axel loads (ESAL).

Class I: (ESAL < 10^4 per year) Includes maintenance mixes, bike paths, parking lots, residential driveways, light traffic residential streets, light traffic rural farm roads.

Class II: (ESAL between 10^4 and10^6 per year). Includes heavy traffic residential streets, rural farm collector roads, non-industrial parking lots, urban low volume collector streets.

Class III: (ESAL > 10^6 per year). Includes high volume collectors, arterials, industrial parking lots (primary load from 3-axle or greater vehicles), climbing lanes, truck weigh stations.

C. **Wheel Path**: A continuous parallel line inside a travel lane 2.5 feet from the lane line or median line.

1.4 SUBMITTALS

A. Traffic control plan, Section 01 55 26.

B. Certifications for profilographs, profilers, and operators.

C. Summary report of smoothness profile testing.

1.5 **QUALITY ASSURANCE**

A. Provide testing equipment and a person capable of calculating grades and cross-slopes in degrees and percentages. Cross slopes vary when the crown line is not parallel to pavement edge line.

1.6 **ACCEPTANCE**

A. **General**:

1. Acceptance is by Lot.
2. Dispute resolution, Section 01 35 10.
3. Opening a profiled surface to traffic does not constitute acceptance.
4. Observation of CONTRACTOR's field quality control testing does not constitute acceptance. Such testing; however, may be used by ENGINEER for acceptance if requirements of Section 01 35 10 are met.

B. **Profile Roughness**:

1. Lot is 0.1 lane mile (528 feet long one lane wide). Add segments shorter than 250 feet to preceding lot. Treat partial segments longer than 250 feet as a lot.
2. Excluded from the lot are turn lanes, parking lanes, medians, Street Fixtures, crowns of intersecting streets, bridge decks, grades greater than eight (8) percent, and vertical curves less than 1,000 feet radius (including super-elevation transitions).

C. **Profile Deviation**: Verify "Must Grind" bumps and depressions are removed from the lot surface. Lot is area of total placement. No area is excluded.

PART 2 PRODUCTS

Not Used

PART 3 EXECUTION

3.1 **CONSTRUCTION EQUIPMENT**

A. **Profilograph**:

1. Capable of producing results required by ASTM E950 and ASTM E1274.
2. Set profilograph readings with corresponding project survey stationing, or as a minimum, correlate equipment station 0+00 with a specific project station number. ENGINEER to select.

B. **Milling and Grinding Machines**:

1. Equipped to prevent air pollution.
2. Equipped with a system to control depth and slope of pavement cut.

C. Cleaning equipment able to pick up millings and waste water.

3.2 PREPARATION

A. **Traffic Control**: Implement traffic control plan requirements, Section 01 55 26. Provide safe passage for pedestrians and vehicles. Do not proceed without certified flaggers if work requires.

B. **Surface Repair**: Method of payment to be determined by ENGINEER if preliminary profiling of existing pavement is required before placement of thin bonded overlay, micro-surfacing, slurry seal, chip seal, etc.

3.3 TOLERANCES

A. **Profile Roughness and Profile Deviation**: Verify bumps and depressions meet tolerance. Trace all wheel paths in direction of travel. Begin traces 50 feet before edge of new pavement or patch and end traces 50 feet after edge of new pavement or patch. Areas (including the 50 feet end trace areas) exceeding profile deviation tolerance are "Must Grind" areas.

Table 1 – Roughness and Deviation Tolerance

Speed mph	Road Class	Profile Roughness Index (PRI) Inches / Mile				Profile Deviation Inches/25 feet Maximum
		IRI		PI		
		Min	Max	Min	Max	
0 to 30	I	–	–	–	–	0.4
	II or III	129	177	46	66	0.4
31 to 45	I or II	90	155	35	50	0.4
	III	70	90	21	35	0.4
>45	All Classes	–	70	–	21	0.3

NOTES
(a) IRI (International Roughness Index), ASTM E 950. Use a 1/4 car.
(b) PI (Profile Index), ASTM E 1274. Use a zero blanking band.
(c) Profile deviation applies to bump and depression measurements.

3.4 REPAIR

A. **General**:

1. Do not begin repairs without ENGINEER's knowledge of such activity.
2. All repair expenses are at no additional cost to OWNER.

B. **Bituminous Concrete Repair**:

1. Smooth out profile irregularities by grinding. See Section 32 01 26.
2. Apply Section 32 12 03 cationic or anionic emulsion at 0.11 ± 0.01 gallons per square yard and a sand friction blotter over all grind areas.
3. If depressions cannot be corrected by grinding, do a cold mill and inlay repair per Section 32 01 16.71 or do a remove and replace patch repair per Section 33 05 25. **Raising depressions with a skin patch and feathered edges is NOT ACCEPTABLE**. Patch profile must meet this section's smoothness requirements.

C. **Portland Cement Concrete Repair**:

1. Smooth out profile irregularities by grinding. See Section 32 01 26.
2. Apply penetrating sealer over all grind areas. See Section 07 19 00.
3. If depressions cannot be corrected by grinding, remove concrete and provide a concrete pavement patch per Section 32 01 19. Patch profile must meet this section's smoothness requirements.

END OF SECTION

SECTION 32 05 10
BACKFILLING ROADWAYS

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Roadway backfill materials.

B. Roadway backfilling requirements.

1.2 REFERENCES

A. **APWA (Utah) Standards**:

Plan 245 Subgrade stabilization.

B. **ASTM Standards**:

D698 Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft-lbf/ft^3 (600 kN-m/m^3)).

D1557 Laboratory Compaction Characteristics of Soil using Modified Effort (56,000 ft-lbf/ft^3 (2,700 kN-m/m^3)).

D2922 Density of Soil and Soil-Aggregate in Place by Nuclear Methods (Shallow Depth).

D4832 Preparation and Testing of Soil-Cement Slurry Test Cylinders.

1.3 DEFINITIONS

A. **Embankment**: A raised earthen structure.

B. **Pavement**: A surface or covering, as of Portland cement concrete, bituminous concrete, brick, concrete paver, etc., specifically a paved street, sidewalk, curb, gutter, curb cut assembly, ramp, apron, Driveway, etc.

C. **Subgrade**: A surface of native earth or Rock leveled off as to receive backfill materials.

1.4 SUBMITTALS

A. Submit maximum laboratory dry density and optimum laboratory moisture content for:

1. Subgrade material.
2. Each type of fill to be used.

B. Submit aggregate batch delivery tickets showing name of material source, serial number of ticket, date and truck number, name of Supplier, job name and location, volume or weight, and aggregate classification or Supplier's identification code.

1.5 QUALITY ASSURANCE

A. Do not change material sources, or aggregate without ENGINEER's knowledge.

B. Reject backfill material that does not comply with requirements specified in this section.

C. If requested, submit a quality control Inspection and testing report describing source and field quality control activities performed by CONTRACTOR and Suppliers.

1.6 STORAGE

A. Safely stockpile backfill materials.

B. Separate differing materials, prevent mixing, and maintain optimum moisture content of backfill materials.

1.7 SITE CONDITIONS

A. Do not place, spread, or roll any backfill material over material that is damaged by water. Remove and replace damaged material at no additional cost to OWNER.

B. Control traffic and erosion. Keep area free of trash and debris. Repair settled, eroded, and rutted areas.

C. Reshape and compact damaged structural roadway section to required density.

D. Soil Cement: Do not spread soil cement mixture when air temperature is less than 40 deg F in the shade.

E. Drainage: Immediately before suspension of construction operations for any reason, provide proper and necessary drainage of work area.

1.8 ACCEPTANCE

A. General: Native material may be wasted if there is no additional cost to substitute material acceptable to ENGINEER.

B. Material: For material acceptance refer to:

1. Common fill, Section 31 05 13.
2. Aggregate base course, Section 32 11 23.
3. Cement treated fill, Section 31 05 15.

C. Lift Thickness: One test per Lot.

D. Compaction: One test per Lot. Verify density using nuclear tests, ASTM D2922. Compaction standard and Lot size as follows:

Table 1 – Compaction Standard and Lot Sizes		
Material	**Proctor**	**Lot Size**
Subgrade	Standard	1000 square yards
Common Fill	Standard	PCC or AC Surface Course: 1,000 square yards per lift Driveway Approach: 400 square feet per lift Sidewalk: 400 linear feet per lift
Aggregate base course	Modified	PCC or AC Surface Course: 1,000 square yards per lift Driveway Approach: 400 square feet per lift Sidewalk: 400 linear feet per lift Curb, Gutter, and Waterways: 200 linear feet per lift
NOTES (a) Standard proctor, ASTM D698. (b) Modified proctor, ASTM D1557.		

E. Flowable Fill Strength: Lot size is one day production with sub-lots of 250 cubic yards or part thereof. Verify strength using cylinders, ASTM D4832.

F. Grade, Cross Slope: Measured at random locations.

1.9 **WARRANTY**

A. Repair incidental settlement or settlement damage at no additional cost to OWNER.

PART 2 PRODUCTS

2.1 **BACKFILL MATERIALS**

A. Common fill, Section 31 05 13: Granular material, CONTRACTOR's choice.

B. Aggregate base course, Section 32 11 23: Untreated base course.

C. Cement treated fill, Section 31 05 15: Use a flowable fill so vibration is not required.

2.2 **WATER**

A. Make arrangements for sources of water during construction and make arrangements for delivery of water to site.

B. Comply with local Laws and Regulations at no additional cost to OWNER when securing water from water utility company.

2.3 **GEOTEXTILE**

A. Stabilization separation fabric, Section 31 05 19: Woven, high MARV.

PART 3 EXECUTION

3.1 PREPARATION

A. Implement traffic control plan requirements, Section 01 55 26.

B. Verify:

1. Backfill material meets gradation requirements.
2. Areas to be backfilled are free of debris, snow, ice or water.
3. Bearing surfaces are not frozen.

C. If ground water is in the intended backfill zone, dewater.

3.2 PROTECTION

A. Protect existing trees, shrubs, lawns, structures, fences, roads, sidewalks, paving, curb and gutter and other features.

B. Protect above or below grade utilities. Contact utility companies to repair utility damage. Pay all cost of repairs.

C. Avoid displacement of and damage to existing installations while compacting or operating equipment. Do not fill adjacent to structures until excavation is checked by ENGINEER.

D. Do not use compaction equipment adjacent to walls or retaining walls that may cause wall to become over-stressed or moved from alignment.

E. Do not disturb or damage foundation perimeter drainage, foundation, damp-proofing, foundation waterproofing and protective cover, or utilities in trenches. Movement of construction machinery over work at any stage of construction is solely at CONTRACTOR's risk.

F. Restore any damaged structure to its original strength and condition.

3.3 LAYOUT

A. Identify required line, levels, contours, and datum.

B. Stake and flag locations of underground utilities.

C. Upon discovery of unknown utility or concealed conditions, notify ENGINEER.

D. Maintain all benchmarks, control monuments and stakes, whether newly established by surveyor or previously existing. Protect from damage and dislocation.

E. If discrepancy is found between Contract Documents and site, ENGINEER shall make such minor adjustments in the Work as necessary to accomplish the intent of Contract Documents without increasing the Cost of the Work to CONTRACTOR or OWNER.

3.4 SUBGRADE

A. Protect Subgrade from desiccation, flooding, and freezing.

B. Before backfilling over Subgrade, get ENGINEER's review of Subgrade surface preparations.

C. If Subgrade is not readily compactable, get ENGINEER's permission to stabilize the Subgrade:

1. Excavation for Subgrade stabilization is incidental work. Section 31 23 16.

2. Place geotextile fabric per APWA Plan 245. Place acceptable fill in lifts over the geotextile, compact and wrap.

3.5 EMBANKMENTS

A. Place backfill material in lifts not exceeding equipment compaction capability.

B. Build shoulders to a grade higher than that of adjacent fills. Provide surface runoff at all times.

C. Commence compaction along edge of area to be compacted and gradually advance toward center.

D. Operate compaction equipment along lines parallel or concentric with the center-line of the embankment being constructed.

E. Do not damage subsurface structures or utilities.

3.6 BASE COURSES

A. Place backfill material in lifts not exceeding eight (8) inches before compaction.

B. Maintain moisture content in compaction operations.

C. Avoid segregation when spreading backfill. Keep surfaces free from pockets of coarse and fine aggregate.

D. Rework fills that do not conform to compaction requirements until requirements are met.

E. Protect cement treated fill against freezing and traffic for seven (7) days.

3.7 MODIFIED BACKFILL LAYER METHOD

A. Section 33 05 20.

3.8 TOLERANCES

A. Compaction: Ninety-five (95) percent or greater relative to a standard or modified proctor density, Section 31 23 26.

B. Lift Thickness (before compaction):

1. Eight (8) inches when using riding compaction equipment.

2. Six (6) inches when using handheld compaction equipment.

3. As proven in the modified backfill layer method, Section 33 05 20.

C. Cement Treated Fill: Compressive strength targets are 60 psi in 28 days. Maximum is 90 psi in 28 days.

3.9 FIELD QUALITY CONTROL

A. Test roadway backfilling until a compaction pattern acceptable to CONTRACTOR and ENGINEER is achieved. Continue random quality control compaction testing.

B. Proof Rolling Test:

1. Before placing fill material for roadbed backfills, proof roll subgrade using gross weight of 18,000 pounds/tandem axle, with a tire pressure at least 90 psi.
2. All proof roll passes will traverse the subgrade parallel to the roadbed centerline. All subsequent passes will be offset 1/2 the vehicle width until the entire subgrade is tested.
3. ENGINEER will analyze, determine, designate and measure the areas, if any, requiring additional compaction or reconstruction.
4. Once subgrade passes the proof rolling test, protect the surface from construction operations and traffic damage. Repair all cuts, ruts, and breaks. Keep surface in a satisfactory condition until geotextile fabric or base course has been placed.

3.10 CLEANING

A. Remove stockpiles from site when work is complete. Grade site to prevent free standing surface water.

B. Leave borrow areas clean and neat.

END OF SECTION

SECTION 32 11 23
AGGREGATE BASE COURSES

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Treated and untreated base course production and placement.

1.2 REFERENCES

A. **AASHTO Standards**:

R9 Acceptance Sampling Plans for Highway Construction.

B. **ASTM Standards**:

C29 Unit Weight and Voids in Aggregate.

C131 Resistance to Degradation of Small-Size Coarse Aggregate by Abrasion and Impact in the Los Angeles Machine.

C117 Materials Finer Than 0.075mm (No. 200) Sieve in Mineral Agtgregates by Washing.

C136 Sieve Analysis of Fine and Coarse Aggregates.

D75 Sampling Aggregates.

D448 Sizes of Aggregate for Road and Bridge Construction.

D1557 Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000 ft-lbf/ft^3 (2,700 kN-m/m^3)).

D1883 CBR (California Bearing Ratio) of Laboratory-Compacted Soils.

D2216 Laboratory Determinations of Water (Moisture) Content of Soil and Rock.

D2419 Sand Equivalent Value of Soils and Fine Aggregate.

D2922 Density of Soil and Soil-Aggregate in Place by Nuclear Methods (Shallow Depth).

D3017 Water Content of Soil and Rock in Place by Nuclear Methods (Shallow Depth).

D3665 Random Sampling of Construction Materials.

D3740 Evaluation of Agencies Engaged in Testing and/or Inspection of Soil and Rock as Used in Engineering Design and Construction.

D4318 Liquid Limit, Plastic Limit, and Plasticity Index of Soils.

D5821 Standard Test Method for Determining the Percentage of Fractured Particles in Coarse Aggregate.

1.3 DEFINITIONS

A. **Master Grading Band**: A graphical area defined by gradation limits allowed for various sieve sizes ranging from the maximum sieve size to the No. 200 sieve.

B. **Target Grading Curve**: A smooth locus of points within the limits of the Master Grading Band.

C. **Target Grading Band**: Gradation limits defined by the allowable variance from the Target Grading Curve. It is possible that these limits may lie outside of the Master Grading Band.

D. **Mean of Deviations**: The sum of the absolute values of the variance between each screen target value and each measured value divided by the number of tests in the Lot.

E. **RAP**: Acronym for reclaimed asphalt pavement. See Section 32 12 16.18.

F. **Lot**: (a) Quantity of aggregate delivered to a site when considering gradation, (b) area of aggregate placed at a site when considering density.

1.4 SUBMITTALS

A. **Mix Design**: Provide the following. Allow ENGINEER 10 days to evaluate the submittal.

1. Date of mix design. If older than 365 days from date of submission, recertify mix design.
2. Name of supplier and aggregate source.
3. Target gradation for each sieve size,
4. Percent composition of reclaimed asphalt or concrete included in the mix.
5. Unit weight, CBR, relative density, and relative moisture content.
6. Aggregate physical properties (this section article 2.1). The information is for suitability of source and not for project control. A new report may be required if aggregate source is changed. Test results shall not be older than 455 days from date of submission.

B. **At Delivery**: Submit batch delivery ticket identifying serial number of ticket, date and truck number, job name, weight of aggregate, mix identification, and description.

1.5 QUALITY ASSURANCE

A. Do not change aggregate source until ENGINEER accepts new source and new mix design.

B. Use a laboratory that follows and complies with ASTM D3740 and Section 01 45 00 requirements.

C. If requested, submit a quality control and testing report describing source and field quality assurance activities performed by CONTRACTOR and Suppliers.

1.6 ACCEPTANCE

A. **General:**

1. Acceptance is by Lot.
2. If non-complying material has been installed and no price for the material is specified, apply pay adjustment against cost of work requiring complying material as part of its installation, Section 01 29 00.
3. ENGINEER is not obligated to accept changes in gradation target after any material is delivered to site.
4. Observation of CONTRACTOR's field quality control testing does not constitute acceptance. Such testing; however, may be used by ENGINEER for acceptance if requirements in Section 01 35 10 are met.
5. Dispute resolution, Section 01 35 10.

B. **Gradation**: Lot size is one (1) day production. Sub-lot size is 500 tons. Collect samples from grade before compaction. Conduct at least one (1) gradation analysis for each lot. Lot is acceptable if gradation test deviations are within pay factor 1.00 limits. At ENGINEER's discretion, a lot with a sub-lot deviation greater than pay factor 0.70 limits may stay in place at 50 percent pay.

Table 1- Gradation Pay Factors

Criteria	Pay Factor	Mean of Deviations of Acceptance Tests From the Target Grading Curve Expressed in Percentage Points				
		1 Sample	2 Samples	3 Sample	4 Sample	5 or More Samples
1/2" and Larger Sieves	1.00	0 – 15	0.0 – 12.1	0.0 – 10.8	0.0 – 10.0	0.0 – 9.5
	0.95	16 – 17	12.2 – 13.9	10.9 – 12.4	10.1 – 11.5	9.6 – 11.
	0.90	18 – 19	14.0 – 15.1	12.5 – 13.5	11.6 – 12.5	11.1 – 11.9
	0.80	20 – 21	15.2 – 17.2	13.6 – 15.3	12.6 – 14.2	12. – 13.5
	0.70	22 – 23	17.3 – 18.8	15.4 – 16.7	14.3 – 15.5	13.6 – 14.7
3/8" Sieve	1.00	0 – 15	0.0 – 11.5	0.0 – 9.8	0.0 – 8.8	0.0 – 8.0
	0.95	16 – 17	11.6 – 13.2	9.9 – 11.3	8.9 – 10.1	8.1 – 9.2
	0.90	18 – 19	13.3 – 14.4	11.4 – 12.3	10.2 – 11	9.3 – 10.0
	0.80	20 – 21	14.5 – 16.3	12.4 – 13.9	11.1 – 12.5	10.1 – 22.4
	0.70	22 – 23	16.4 – 17.9	14.0 – 15.2	12.6 – 13.6	11.5 – 12.4
No. 4 Sieve	1.00	0 – 14	0.0 – 10.5	0.0 – 8.8	0.0 – 7.8	0.0 – 7.0
	0.95	15 – 17	10.6 – 12.1	8.9 – 10.1	7.9 – 9.0	7.1 – 8.0
	0.90	18	12.2 – 13.1	10.2 – 11	9.1 – 9.8	8.1 – 8.7
	0.80	19 – 20	13.2 – 14.9	11.1 – 12.5	9.9 – 11.1	8.8 – 10.0
	0.70	21 – 22	15.0 – 16.3	12.6 – 13.6	11.2 – 12.1	10.1 – 10.8
No. 16 Sieve	1.00	0 – 11	0.0 – 8.2	0.0 – 6.9	0.0 – 6.2	0.0 – 5.6
	0.95	12 – 13	8.3 – 9.4	7.0 – 7.9	6.3 – 7.1	5.7 – 6.4
	0.90	14	9.5 – 10.3	8.0 – 8.6	7.2 – 7.8	6.5 – 7.0
	0.80	15 – 16	10.4 – 11.6	8.7 – 9.8	7.9 – 8.8	7.1 – 8.0
	0.70	17	11.7 – 12.7	9.9 - 10.7	8.9 – 9.6	8.1 – 8.7

No. 200 Sieve	1.00	0 – 4.5	0.0 – 3.4	0.0 – 2.9	0.0 – 2.5	0.0 – 2.3
	0.95	4.6 – 5.2	3.5 – 3.9	3.0 – 3.3	2.6 – 2.9	2.4 – 2.6
	0.90	5.3 – 5.6	4.0 – 4.3	3.4 – 3.6	3.0 – 3.1	2.7 – 2.9
	0.80	5.7 – 6.4	4.4 – 4.9	3.7 – 4.1	3.2 – 3.6	3.0 – 3.3
	0.70	6.5 – 7.0	4.9 – 5.3	4.2 – 4.5	3.7 – 3.9	3.5 – 3.6

NOTES
(a) ENGINEER has 36 hours after Lot placement to accept aggregate gradation. CONTRACTOR may place material over the crushed aggregate base material during the 36 hours interval at its own risk. Pay factors for the Lot will NOT be applicable if ENGINEER performs tests after the 36 hours interval.

C. **Relative Density**: Lot size 10,000 cubic yards. Conduct at least one laboratory determination to be used as a standard for field density and field moisture content determinations.

D. **Field Density**: Lot size is one (1) day placement. Number of density tests varies according to placement type, location and sub-lot size (Table 2). Conduct at least one (1) field density test in the lot. Select each test location randomly.

Table 2 - Placement Type, Location, Sub-lot Size

Type	Location	Sub-lot Size
I	Pavement (includes curb, gutter and water way when in conjunction with pavement placement).	1,000 square yards
II	Curb, gutter, waterway	200 linear feet
	Sidewalk	400 linear feet
	Driveway approach, curb cut assembly, waterway transition structure, flat work	400 square feet
III	Landscaping and other non-structural, non- load bearing areas	--

PART 2 PRODUCTS

2.1 UNTREATED BASE COURSE

A. **Material**: Crushed rock, gravel, sand, or other high quality mineral particle, or combination that is free of organic matter, free of chemical or petroleum contamination, and meets the following physical properties.

Table 3 – Untreated Base Course Physical Properties				
	ASTMs	Aggregate Class		
		A	B	C
Coarse aggregate				
Angularity (2 fractured faces), min., percent	D5821	50	–	–
Wear (toughness or hardness), max., percent	C131	50		
Fine aggregate				
Liquid Limit, max.	D4318	25		
Plastic Index, max.	D4318	0	0	6
Sand Equivalent, min., percent	D24 19	35		
Blended aggregate				
Dry Rodded Unit Weight, min., percent	C29	75		
CBR, min., percent	D1883	70	55	--

NOTES
(a) Faces: Retained on No. 4 sieve.
(b) Wear: Retained on No. 12 sieve after 500 revolutions.
(c) Liquid limit and plastic index: Passing No. 40 sieve.
(d) Sand equivalent (clay content or cleanliness): Passing No. 4 sieve.
(e) CBR: Use a surcharge of 10 pounds measured at 0.20 inch penetration at 95 percent relative to a modified proctor density. A reduction in aggregate class may be accepted providing any costs for difference in excavation, backfill, and alternate design for CBR does not increase Concrete Price.

B. **Gradation**: Analyzed according to ASTM C136 on a dry weight and percent passing basis. Target Grading Curve must lie within the selected aggregate grade in table 4. Field gradation shall not vary from target by more than the target tolerance.

Table 4 – Master Grading Bands				
Sieve	Aggregate Grade			Target Tolerance
	Grade 1-1/2	Grade 1	Grade 3/4	
1-1/2"	100	–	–	(Pay factor 1.00 in Table 1)
1 "	–	100	–	
3/4 "	70 – 85	–	100	
1/2 "	–	79 – 91	–	
3/8 "	55 – 75	–	78 – 92	
No. 4	40 – 65	49 – 61	55 – 67	
No. 16	25 – 40	27 – 35	28 – 38	
No. 200	7 – 11	7 – 11	7 – 11	

NOTES
(a) It is assumed fine and course aggregate have same bulk specific gravity.
(b) Target tolerance for 3/4 sieve in Grade 3/4, and 1" sieve in Grade 1 is not applicable.
(c) Percentage of fines passing No. 200 sieve determined by washing, ASTM C117.

C. **Changing Source**: A new material properties report is required.

2.2 **TREATED BASE COURSE**

A. Treatment includes addition of lime, cement slurry, asphalt emulsion, RAP, crushed concrete, or any combination, or other material acceptable to ENGINEER.

B. Base course containing RAP:

1. Meet requirements of this section article 2.1 and the following:

a. Sand equivalent and fractured face measured after asphalt residue is burned off.

b. Plasticity and wear requirements apply to virgin aggregate portion only.

c. Allowable asphalt content is controlled by allowable CBR.

2. Remove debris from crushed RAP aggregate by screening.

3. Mechanically blend virgin and RAP aggregates. Do not use windrows for blending.

C. Base course containing crushed concrete.

1. Meet requirements of this section article 2.1 and the following:

a. Cement with its chemical components is allowed.

b. Wear test and fractured face test not required.

2.3 **SOURCE QUALITY CONTROL**

A. Reject crushed aggregate base products that do not meet requirements of this Section.

B. Sampling Protocol: Random location selection, ASTM D3665. Sample collection, ASTM D75.

C. Testing Protocol: Gradation, ASTM C136. Maximum density, ASTM D1557. Optimum moisture content, ASTM D2216.

PART 3 EXECUTION

3.1 **SUB-BASE PREPARATION**

A. Trenches, Section 33 05 20.

B. Structures, Section 31 23 23.

C. Landscaping, Section 32 91 19.

D. Pavements, Section 32 05 10.

3.2 **PLACEMENT**

A. General:

1. Place uniform lifts not exceeding eight (8) inches before compaction.

2. Maintain optimum moisture content plus or minus two (2) percent.

3. Use appropriate compaction equipment.
4. Do not place additional material on any unaccepted layer or on any frozen surface.

B. Provide aggregate suitable for the following locations.

Table 5 - Placement Type, Location, Aggregate Class

Type	Location	Aggregate Class		
		A	B	C
I	Pavement (includes curb, gutter and waterway when in conjunction with pavement placement)	X		
II	Concrete flat work (includes driveway approach, curb cut assembly, curb, gutter, sidewalk, waterway, etc.	X	X	
III	Landscape (includes non-structural, non-load bearing areas.	X	X	X

NOTES:
(a) **X** indicates where placement is allowed.

C. Compaction:
1. Type I and Type II Placement: 95 percent minimum.
2. Type III Placement: Suitable to overlying surface, or installation, or use. Verify compactive effort with ENGINEER.

D. Finish: Uniform with surface deviation no more than 3/8 of an inch from line and grade in 10 feet in any direction.

3.3 FIELD QUALITY CONTROL

A. Sampling Protocol: Random location selection, ASTM D3665. Sample collection, ASTM D75.

B. Testing Protocol: Gradation, ASTM C136. Field density, ASTM D2922. Moisture content, ASTM D3017.

3.4 REPAIR OR REMOVAL

A. If product is correctable and at no additional cost to OWNER, provide laboratory data showing design CBR has not been reduced and material in-place has been compacted to 97 percent minimum.

B. Remove any product that cannot be corrected and install acceptable product at no additional cost to OWNER.

END OF SECTION

SECTION 32 12 03
ASPHALT BINDERS

PART 1 GENERAL

1.1 SECTION INCLUDES

A. An asphalt-based cement that is produced from petroleum residue either with or without the addition of non-particulate, non-fibrous organic modifiers.

B. Requirements for accepting non-complying Asphalt Binders.

1.2 REFERENCES

A. **ASTM Standards**:

D113 Ductility of Bituminous Materials.

D977 Emulsified Asphalt.

D2026 Cutback Asphalt (Slow-Curing Type).

D2027 Cutback Asphalt (Medium-Curing Type).

D2028 Cutback Asphalt (Rapid-Curing Type).

D2397 Cationic Emulsified Asphalt.

D3381 Viscosity-Graded Asphalt Cement for Use in Pavement Construction.

D4552 Classifying Hot-Mix Recycling Agents.

D5710 Trinidad Lake Modified Asphalt.

D6373 Performance Graded Asphalt Binder.

1.3 SUBMITTALS

A. Submit bill of lading for each shipment of Asphalt Binder from vendor. Identify the following:

1. Source of product (manufacturer);
2. Type and grade of asphalt, and
3. Type and amount of additives in the product.

1.4 QUALITY ASSURANCE

A. Reject Asphalt Binders that are not uniform in appearance and consistency or foams at hot mixing temperature.

B. Do not use storage containers contaminated with other types or grades of petroleum products.

C. Do not use petroleum product that does not comply with contract requirements.

1.5 ACCEPTANCE

A. **General**:

1. Acceptance is by Lot. One (1) Lot is one (1) day production.
2. If non-complying material has been installed and no price for the material is specified, apply pay adjustment against cost of work requiring material as part of its installation. Section 01 29 00
3. Dispute resolution, Section 01 35 10.

B. **Performance Graded Asphalt Binder (PGAB):** Sub-lot size is 20,000 gallons. Collect sub-lot Samples randomly from oil storage unit.

1. Meet limits published in Section 209 of UDOT's "Manual of Instruction, Part 8 Materials". Pay reductions are as follows:
   a. If none of the critical properties are outside rejection limit a composite pay adjustment of 25 percent or less is allowed.
   b. If one or more of the critical properties falls outside the rejection limit or if a composite pay adjustment is more than 25 percent, Asphalt Binder will be rejected.

C. **Asphalt Cement (AC) Binder**: Sub-lot size is 20,000 gallons. Collect sub-lot Samples randomly from oil storage unit.

1. Ductility: Meet this section's requirements, <u>or</u>
2. Viscosity or Penetration: Meet graphics published in Section 955 of UDOT's "Manual of Instructions, Part 8 Materials":
   a. Lot may be accepted using the published graphics. If pay adjustment exceeds 30 percent, reject Asphalt Binder, or
   b. If allowed to remain after placement, pay adjustment will be 50 percent.

D. **Cut-back Binder**: Meet this section's requirements for ductility.

E. **Trinidad Lake Modified Asphalt**: Supplier's certificate for ASTM compliance.

F. **Emulsified Asphalt**: Supplier's certificate for ASTM compliance.

G. **Recycle Asphalt**: Identity of source (asphalt cement or tar products).

H. **Crack Patch**: Meet material requirements in Section 32 01 17.

PART 2 PRODUCTS

2.1 PERFORMANCE GRADE ASPHALT BINDER (PGAB)

A. Petroleum asphalt that complies with ASTM D6373. Blending binder with polymers, crumb rubber, or natural bitumens is CONTRACTOR's choice.

2.2 ASPHALT CEMENT (AC)

A. Petroleum asphalt that complies with Table 2 of ASTM D3381 except as follows:

1. Replace ductility, ASTM D113, at 77 deg F (25 deg. C) with ductility at 39.2 deg F (4 deg. C). Use the following values.
   - AC-5: greater than 25.
   - AC-10: greater than 15.
   - AC-20: greater than 5.
2. Delete the loss on heating requirement on residue from "Thin-Film Oven Test".

B. AC-5 Latex Additive: Anionic emulsion of butadiene-styrene low-temperature copolymer consisting of two (2) percent by weight (solids basis), stabilized with fatty-acid soap for storage stability.

2.3 TRINIDAD LAKE MODIFIED ASPHALT (TLA)

A. Petroleum asphalt that complies with ASTM D5710 (a blend of natural bitumens).

2.4 SLOW CURE CUT-BACK ASPHALT (SC)

A. Petroleum asphalt that complies with ASTM D2026 (fluxed with a light oil) except if penetration of residue is more than 200 and its ductility at 77 deg. F (25 deg. C) is less than 100 cm., the material will be acceptable if the ductility at 59 deg F (15 deg. C) is greater than 100.

2.5 MEDIUM CURE CUT-BACK ASPHALT (MC)

A. Petroleum asphalt that complies with ASTM D2027 (fluxed or blended with a kerosene type solvent, non-foaming when heated to application temperature) except if penetration of residue is more than 200 and its ductility at 77 deg F (25 deg. C) is less than 100 cm., the material will be acceptable if the ductility at 59 deg F (15 deg. C) is greater than 100.

2.6 RAPID CURE CUT-BACK ASPHALT (RC)

A. Petroleum that complies with ASTM D2028 asphalt (fluxed or blended with a naphtha solvent, non-foaming when heated to application temperature).

2.7 EMULSIFIED ASPHALT

A. Petroleum asphalt uniformly emulsified with water, homogeneous throughout, and when stored, shows no separation within 30 days after delivery. Frozen emulsions not accepted:

1. Anionic, ASTM D977 (breaks by evaporation).
2. Cationic, ASTM D2397 (breaks chemically).

2.8 RECYCLE ASPHALT (RA)

A. Petroleum asphalt that complies with ASTM D4552 (homogeneous, free-flowing at pumping temperature made from maltene fractions of asphalt cement for surface revitalization or from tar products to make Pavements resistant to fuel spillage:

1. RA-1, RA-5, RA-25 or RA-75 for recycling RAP aggregate when less than 30 percent virgin aggregate is added.
2. RA-250 or RA-500 when more than 30 percent virgin aggregate is added to RAP.

2.9 WARM-MIX ASPHALT (WMA)

A. Performance grade Asphalt Binder or asphalt cement binder blended with a wax, foam, chemical, or organic additive.

PART 3 EXECUTION

3.1 INSTALLATION

A. Prime coat, Section 32 12 13.19.

B. Tack coat, Section 32 12 13.13.

C. Plant mix paving, Section 32 12 16.13.

D. Road mix paving, Section 32 12 16.19.

E. Slurry seal coating, Section 32 01 13.61.

F. Crack sealing, Section 32 01 17.

END OF SECTION

SECTION 32 12 05
BITUMINOUS CONCRETE

PART 1 GENERAL

1.1 **SECTION INCLUDES**

A. Composition of a bituminous concrete mix.

1.2 **REFERENCES**

A. **AASHTO Standards**:

M323 Superpave Volumetric Mix Design, Single User Digital Publication

R30 Mixture Conditioning of Hot-Mix Asphalt (HMA)

T324 Hamburg Wheel-Track Testing of Compacted Hot-Mix Asphalt (HMA)

B. **AI Standards**:

MS-2 Asphalt Mix Design Methods.

C. **ASTM Standards**:

C29 Unit Weight and Voids in Aggregate.

C88 Soundness of Aggregates by Use of Sodium Sulfate or Magnesium Sulfate.

C117 Materials Finer Than 0.075mm (No. 200) Sieve in Mineral Aggregates by Washing.

C131 Resistance to Degradation of Small-Size Coarse Aggregate by Abrasion and Impact in the Los Angeles Machine.

C136 Standard Method for Sieve Analysis of Fine and Coarse Aggregate.

C142 Clay Lumps and Friable Particles in Aggregates.

D75 Sampling Aggregates.

D140 Sampling Bituminous Materials.

D242 Mineral Filler for Bituminous Paving Mixtures.

D979 Sampling Bituminous Paving Mixtures.

D995 Mixing Plants for Hot-Mixed, Hot-Laid Bituminous Paving Mixtures.

D2041 Theoretical Maximum Specific Gravity of Bituminous Paving Mixtures.

D2419 Sand Equivalent Value of Soils and Fine Aggregate.

D3203 Percent Air Voids in Compacted Dense and Open Bituminous Paving Mixtures.

D3515 Hot-Mixed, Hot-Laid Bituminous Paving Mixtures.

D3665 Random Sampling of Construction Materials.

D3666 Minimum Requirements for Agencies Testing and Inspecting Bituminous Paving Materials.

D4318 Liquid Limit, Plastic Limit, and Plasticity Index of Soils.

D4552 Classifying Hot-Mix Recycling Agents.

D4791 Flat or Elongated Particles in Coarse Aggregate.

D4867 Effect of Moisture on Asphalt Concrete Paving Mixtures.

D5444 Mechanical Size Analysis of Extracted Aggregate.

D5821 Determining the Percentage of Fractured Particles in Coarse Aggregate.

D6307 Determining Asphalt Content of Hot-Mix Asphalt by Ignition Method.

D6373 Performance Graded Asphalt Binder.

D6927 Marshall Stability and Flow of Bituminous Mixtures.

1.3 **DEFINITIONS**

A. **Mix Designator**: An alphanumeric code that identifies binder grade, aggregate grade, and compaction level for a bituminous concrete mix. For example.

- *PG70-28, SP-1, 75Nd***:** PG70-28 is a Performance Graded Asphalt Binder. SP-1 is the aggregate grade. 75Nd is the compaction level at Superpave mix design.
- *OS/PG, SP-3/4, 75Nd*: OS/PG is a Blended Binder. SP-3/4 is the aggregate grade. 75ND is the compaction level at Superpave mix design.
- *PG64-22, DM-1/2, 50 blow*: PG64-22 is a Performance Graded Asphalt Binder. DM-1/2 is the aggregate grade. 50 blow is the compaction level at Marshall mix design.
- *OS/PG, DM-3/4, 50 blow*: OS/PG is a Blended Binder. DM-3/4 is the aggregate grade. 50 blow is the compaction level at Marshall mix design.

B. **Bituminous Binder**: A cement composed of any of several viscous or solid mixtures of hydrocarbons and their nitrogen and sulfur derivatives.

1. Asphalt Binder: A refined or manufactured bituminous cement known as performance graded asphalt binder (PG or PGAB) whether virgin or contained in RAP.
2. Bitumen Binder: A natural bituminous cement contained in an Oil Sand (OS) or contained in a ROSP.
3. Blended Binder: A Mixture of Asphalt Binder and Bitumen Binder.

C. **Mean of Deviations**: Defined in Section 32 11 23.

D. **Nominal Maximum Size**: One sieve size larger than first sieve size retaining more than 10 percent of the Sample. One hundred percent of the aggregate might be able to pass through the nominal maximum size sieve but not more than 10 percent will be retained on that sieve. The maximum size sieve will be one (1) sieve size larger than the nominal

maximum size.

E. **Oil Sand (OS):** Naturally occurring sediments or sedimentary rock containing gravel, sand, clay, water and bituminous cement.

F. **RAP**: Acronym for reclaimed asphalt pavement. A granular product recovered from a bituminous pavement containing aggregate and an Asphalt Binder.

G. **ROSP**: Acronym for reclaimed Oil Sand pavement. A granular product recovered from a bituminous pavement containing aggregate and a Bitumen Binder.

1.4 **SUBMITTALS**

A. **General**:

1. Pre-approved Mix Design: Submit name and address of Supplier.
2. Allow ENGINEER 10 days to evaluate mixing equipment and mix design submittals.
3. Once a mix design is accepted, a new mix design submittal is required if the following occurs.
   a. Asphalt Binder grade is changed.
   b. Aggregate source is changed. When this occurs, submit a physical properties report on the proposed aggregates.

B. **Quality Assurance**:

1. Independent Laboratory: Submit names, certification levels, and years of experience of testing agency's field technicians that are assigned to the Work. Verify laboratory complies with ASTM D3666. and follows Section 01 45 00 requirements.
2. Mix Production Equipment: Submit verification by an individual acceptable to ENGINEER, that plant equipment complies with requirements of ASTM D995.
3. Testing Report: If requested by ENGINEER, submit a report of source and field quality control testing performed by CONTRACTOR and Suppliers.

C. **Mix Design**: Submit the following.

1. Date of mix design. If the date exceeds the following times, the mix design is invalid and must be redesigned.
   a. One (1) year for non-commercial plants.
   b. Two (2) years for commercial plants if there is no change in the aggregate source. A new mix design will be required if aggregate source is changed.
2. Binder source, type, and grade. Disclose if RAP or ROSP is used in the mix.
3. Optimum compaction temperature at the project site.
4. Theoretical maximum specific gravity.
5. Compaction density at design target air voids.
6. Target Grading Curve for aggregate.

7. Binder target percentage, dust to binder ratio, and the following as applicable.
   a. For Superpave mix design provide 1) voids in the mineral aggregate (VMA), and 2) voids filled with Bituminous Binder also known as VFA, and 3) Hamburg Wheel Tracker results.
   b. For Marshall mix design provide 1) tensile strength ratio (moisture sensitivity), 2) voids in the mineral aggregate (VMA), 3) stability, 4) flow and 5) voids in the bituminous mix, and 6) voids filled with Bituminous Binder also known as VFA.
8. Percentages of 1) mineral filler, 2) anti-strip, 3) reclaimed bituminous pavement (RAP or ROSP), 4) recycle agent in the mix, and 5) virgin aggregate.
9. Aggregate physical properties (this section article 2.2). The information is for suitability of source and not for project control. A new report may be required if aggregate source is changed. Test results shall not be older than two (2) calendar years from the date of submission.

1.5 QUALITY ASSURANCE

A. Do not change aggregate source or binder source until ENGINEER accepts new sources and mix design.

1.6 ACCEPTANCE

A. **General**:
   1. Acceptance is by Lot. One (1) Lot is one (1) days' production.
   2. If non-complying material has been installed and no price for the material is specified, apply pay adjustment against cost of work requiring material as part of its installation, Section 01 29 00.
   3. If test results are not within this section's limits, options include correction of production procedures or production of an alternate mix design acceptable to ENGINEER.
   4. Observation of CONTRACTOR's field quality control testing does not constitute acceptance. Such testing; however, may be used by ENGINEER for acceptance if requirements in Section 01 35 10 are met.
   5. Dispute resolution, Section 01 35 10.

B. **Mix Sampling and Testing**:
   1. Sub-lot size is 500 tons or part thereof.
   2. Sampling Protocol: ASTM D3665 and ASTM D979. Collect at least one (1) random Sample per sub-lot from behind paver and before compaction. Any sample collected because of non-uniform appearance shall not be used in determining a pay factor for the Lot.
   3. Testing Protocol: Field samples will be compacted in the laboratory and tested for:
      a. Air voids, ASTM D3203.
      b. Voids in the mineral aggregate, AI MS 2.

c. Binder content, ASTM D6307.

d. Aggregate gradation, ASTM D5444.

C. **Pay Reduction**: Lot is acceptable if binder content and aggregate gradation test deviations are within pay factor 1.00 limits in Table 1 or Table 2 as applicable. At ENGINEER's discretion a Lot with a sub-lot test deviation greater than pay factor 0.85 limits may stay in place at 50 percent pay.

Table 1 – Pay Factors – Superpave Mix Design

Criteria	Pay Factor	Range of Mean of Deviations of Tests Results in Percentage Points from Binder and Gradation Targets			
		500 Tons	1,000 Tons	1,500 Tons	≥ 2,000 Tons
Binder Content	1.00	0.0 – 0.7	0.0 – 0.54	0.0 – 0.46	0.0 – 0.41
	0.975	0.71 – 0.8	0.55 – 0.61	0.47 – 0.52	0.42 – 0.46
	0.95	0.81 – 0.9	0.62 – 0.68	0.53 – 0.58	0.47 – 0.52
	0.90	0.9 – 1.0	0.69 – 0.75	0.59 – 0.64	0.53 – 0.56
	0.85	1.01 – 1.1	0.76 – 0.82	0.65 – 0.69	0.57 – 0.61
1/2" and larger Sieve	1.00	0.0 – 10.0	0.0 – 7.3	0.0 – 6.3	0.0 – 5.6
	0.975	11.0 – 12.0	7.4 – 8.3	6.4 – 7.1	5.7 – 6.3
	0.95	13.0 – 13.9	8.4 – 9.3	7.2 – 7.9	6.4 – 7.0
	0.90	14.0 – 14.9	9.4 – 10.3	8.0 – 8.7	7.1 – 7.7
	0.85	15.0 – 16.0	10.4 – 11.3	8.8 – 9.5	7.8 – 8.4
3/8" Sieve	1.00	0.0 – 9.9	0.0 – 6.9	0.0 – 5.9	0.0 – 5.3
	0.975	10.0 – 10.9	7.0 – 7.8	6.0 – 6.6	5.4 – 5.9
	0.95	11.0 – 11.9	7.9 – 8.7	6.7 – 7.3	6.0 – 6.6
	0.90	12.0 – 13.9	8.8 – 9.6	7.4 – 8.0	6.7 – 7.2
	0.85	14.0 – 15.0	9.7 – 10.5	8.1 – 8.9	7.3 – 7.9
No. 4 Sieve	1.00	0.0 – 9.9	0.0 – 6.7	0.0 – 5.7	0.0 – 5.2
	0.975	10.0 – 10.9	6.8 – 7.6	5.8 – 6.3	5.3 – 5.8
	0.95	11.0 – 11.9	7.7 – 8.5	6.4 – 6.9	5.9 – 6.4
	0.90	12.0 – 12.9	8.6 – 9.4	7.0 – 7.5	6.5 – 7.0
	0.85	13.0 – 14.0	9.5 – 10.2	7.6 – 8.0	7.1 – 7.6
No. 8 Sieve	1.00	0.0 – 7.9	0.0 – 5.6	0.0 – 4.8	0.0 – 4.3
	0.975	8.0 – 8.9	5.7 – 6.3	4.9 – 5.4	4.4 – 4.8
	0.95	9.0 – 9.9	6.4 – 7.0	5.5 – 6.0	4.9 – 5.3
	0.90	10.0 – 10.9	7.1 – 7.7	6.1 – 6.6	5.4 – 5.8
	0.85	11.0 – 12.0	7.8 – 8.5	6.7 – 7.2	5.9 – 6.4
No. 200 Sieve	1.00	0.0 – 3.0	0.0-2.4	0.0 – 2.0	0.0 – 1.8
	0.975	3.1 – 3.5	2.5 – 2.7	2.1 – 2.2	1.9 – 2.0
	0.95	3.6 – 4.0	2.8 – 3.0	2.3 – 2.4	2.1 – 2.2
	0.90	4.1 – 4.5	3.1 – 3.3	2.5 – 2.7	2.3 – 2.4
	0.85	4.6 – 5.0	3.4 – 3.6	2.8 – 3.0	2.5 – 2.6

NOTES
(a) Test binder content using a burn-off oven, ASTM D6307.
(b) Determine aggregate gradation by extraction, ASTM D5444.

Table 2 – Pay Factors - Marshall Mix Design						
Criteria	**Pay Factor**	**Range of Mean of Deviations of Tests Results from the Binder and Gradation Targets in Percentage Points**				
		500 Tons	**1,000 Tons**	**1,500 Tons**	**2,000 Tons**	**≥2,500 Tons**
Binder Content	1.00	0.00–0.70	0.00–0.54	0.00–0.46	0.00–0.41	0.00–0.38
	0.975	0.71–0.80	0.55–0.61	0.47–0.52	0.42–0.46	0.39–0.43
	0.95	0.81–0.90	0.62–0.68	0.53–0.58	0.47–0.52	0.44–0.47
	0.90	0.91–1.00	0.69–0.75	0.59–0.64	0.53–0.56	0.48–0.52
	0.85	1.01–1.10	0.76–0.82	0.65–0.69	0.57–0.61	0.53–0.56
1/2"and larger Sieve	1.00	0.0–10.9	0.0–7.3	0.0–6.5	0.0–5.6	0.0–5.2
	0.975	11.0–12.9	7.4–8.3	6.4–7.1	5.7–6.3	5.3–5.8
	0.95	13.0–13.9	8.4–9.3	7.2–7.9	6.4–7.0	5.9–6.4
	0.90	14.0–14.9	9.4– 10.3	8.0–8.7	7.1–7.7	6.5–7.1
	0.85	15.0–16.0	10.4–11.3	8.8–9.5	7.8–8.4	7.2–7.7
3/8" Sieve	1.00	0.0–9.9	0.0–6.9	0.0–5.9	0.0–5.3	0.0–4.9
	0.975	10.0–10.9	7.0–7.8	6.0–6.6	5.4–6.9	5.0–5.5
	0.95	11.0–11.9	7.9–8.7	6.7–7.3	6.0–6.6	5.6–6.1
	0.90	12.0–13.9	8.8–9.6	7.4–8.0	6.7–7.2	6.2–6.6
	0.85	14.0–15.0	9.7–10.5	8.1–8.9	7.3–7.9	6.7–7.2
No. 4 Sieve	1.00	0.0–9.9	0.0–6.7	0.0–5.7	0.0–5.2	0.0–4.8
	0.975	10.0–11.0	6.8–7.6	5.8–6.3	5.3–5.8	4.9–5.4
	0.95	11.1–11.9	7.7–8.5	6.4–6.9	5.9–6.4	5.5–5.9
	0.90	12.0–12.9	8.6–9.4	7.0–7.5	6.5–7.0	6.0–6.5
	0.85	13.0-14.0	9.5–10.2	7.6–8.0	7.1–7.6	6.6–7.0
No. 8 Sieve	1.00	0.0–7.9	0.0–5.6	0.0–4.8	0.0–4.3	0.0–4.0
	0.975	8.0–8.9	5.7–6.3	4.9–5.4	4.4–4.8	4.1–4.5
	0.95	9.0–9.9	6.4–7.0	5.5–6.0	4.9–5.3	4.6–4.9
	0.90	10.0–10.9	7.1–7.7	6.1–6.6	5.4–5.8	5.0–5.4
	0.85	11.0–12.0	7.8–8.5	6.7–7.2	5.9–6.4	5.5–5.8
No. 16 Sieve	1.00	0.0–7.9	0.0–5.2	0.0–4.6	0.0–4.2	0.0–3.9
	0.975	8.0–8.9	5.3–5.8	4.7–5.1	4.3–4.6	4.0–4.3
	0.95	9.0–9.9	5.9–6.4	5.2–5.6	4.7–5.1	4.4–4.7
	0.90	10.0–10.9	6.5–7.0	5.7–6.1	5.2–5.5	4.8–5.1
	0.85	11.0–12.0	7.1–7.6	6.2–6.6	5.6–5.9	5.2–5.4
No. 50 Sieve	1.00	0.0–6.9	0.0–4.3	0.0–3.8	0.0–3.4	0.0–3.2
	0.975	7.0–7.9	4.4–4.8	3.9–4.1	3.5–3.8	3.3–3.5
	0.95	8.0–8.9	4.9–5.3	4.2–4.5	3.9–4.1	3.6–3.8
	0.90	9.0–9.9	5.4–5.8	4.6–4.9	4.2–4.4	3.9–4.1
	0.85	10.0–11.0	5.9–6.4	5.0–5.5	4.5–4.9	4.2–4.5
No. 200 Sieve	1.00	0.0–3.0	0.0–2.4	0.0–2.0	0.0–1.8	0.0–1.7
	0.975	3.1–3.5	2.5–2.7	2.1–2.2	1.9–2.0	1.8–1.9
	0.95	3.6–4.0	2.8–3.0	2.3–2.4	2.1–2.2	2.0–2.1
	0.90	4.1–4.5	3.1–3.3	2.5–2.7	2.3–2.4	2.2–2.3
	0.85	4.6–5.0	3.4–3.6	2.8–3.0	2.5–2.6	2.4–2.5

NOTES
(a) Test binder content using a burn-off oven, ASTM D6307.
(b) Determine aggregate gradation by extraction, ASTM D5444.

D. **Installation**: See Section 32 12 16.13 acceptance requirements.

PART 2 PRODUCTS

2.1 BINDER

A. **Performance Graded Asphalt Binder (PGAB)**: See ASTM D6373.

1. Blending with polymers is allowed.
2. Do not use acid blends without documentation supporting need.
3. Adjust binder grade according to AASHTO M323 to account for any binder stiffness caused by adding RAP or ROSP to the mix.

B. **Bitumen Binder**: Oil Sand (OS) source is CONTRACTOR's choice.

C. **Blended Binder**: CONTRACTOR's choice. A blended ratio of Asphalt Binder to Bitumen Binder in the range of about 1:4 to about 4:1 may require patent licensure (Reference: US RE39, 289 E). CONTRACTOR to verify.

2.2 AGGREGATE

A. Crushed stone, crushed gravel,slag, sand, or combination.

B. Use Table 3 to determine suitability of aggregate source.

Table 3 – Aggregate Physical Properties

		Standard	Road Class	
			I & II	III
Coarse Aggregate				
Angularity, percent, minimum	One Fractured face	D5821	90	95
	Two Fractured faces		90	90
Wear (hardness or toughness), percent, maximum		C131	35	35
Flats or elongates (3:1 length to width), percent, maximum		D4791	--	20
Fine Aggregate				
Angularity (uncompacted void content), percent, minimum		T304	40	45
Sand equivalent, percent, minimum		D2419	45	60
Plastic limit, maximum		D4318	0	0
Blended Physical Properties				
Dry-rodded Unit Weight, lb/ft^3, minimum		C29	75	75
Weight Loss (Soundness), percent, maximum		C88	16	16
Friable particles, percent, maximum		C142	2	2

NOTES

(a) Road Class is defined in Section 32 01 31.

(b) Course aggregate does not pass No. 4 sieve. Fine aggregate does pass.

(c) Angularity is determined by weight.

(d) Wear of aggregate may have higher values if aggregate source is known to have higher values.

(e) Sand equivalent is waived for RAP or ROSP aggregate but applies to the

remainder of the aggregate blend.

(f) Plastic limit, passing No. 40 sieve. Aggregate is non-plastic even when filler material is added to the aggregate.

(g) Weight loss, using sodium sulfate.

(g) Friable particles are clay lumps, shale, wood, mica, coal passing the No. 4 sieve, and other deleterious materials.

2.3 ADDITIVES

A. Mineral Filler: ASTM D242.

B. Recycle Agent: ASTM D4552.

C. Anti-strip Agent: Heat stable cement slurry, lime slurry, or chemical liquid.

D. RAP or ROSP: Free of detrimental quantities of deleterious materials.

1. Allowed up to 15 percent by weight of RAP or binder, whichever is lesser, with no change in specified binder grade.
2. Allowed from 15 to 30 percent by weight of RAP or binder, whichever is lesser, if the binder grade is adjusted according to AASHTO M323 to meet the specified binder grade.
3. Determine RAP binder content by chemical extraction.

2.4 MIX DESIGN

A. **Preparation**:

1. Get the Mix Designator and the Road Class from the OWNER, ENGINEER, or bid documents.
2. Use paragraph 1.4C to determine submittal requirements.

B. **Aggregate Gradation – Superpave Mix Design:** See Table 4. The Target Gradation Curve for the specified aggregate grade must lie within the Master Grading Band limits. The target grading band limits for the Target Grading Curve are the appropriate grading limits for pay factor 1.00 in Table 1. The target grading band limits are allowed to extend outside of the Master Grading Band limits.

Table 4 - Master Grading Bnds - Superpave Mix Design

Sieve	Grade			
	SP-1	SP-3/4	SP-1/2	SP-3/8
1.5 inch	100.0	–	–	--
1 inch	90.0 – 100.0	100.0	–	--
3/4 inch	< 90	90.0 – 100.0	100.0	–
1/2 inch	–	< 90	90.0 – 100.0	100.0
3/8 inch	–	–	< 90	90.0 – 100.0
No. 4	–	–	–	< 90
No. 8	19.0 – 45.0	23.0 – 49.0	28.0 – 58.0	32.0 – 67.0
No. 200	1.0 – 7.0	2.0 – 8.0	2.0 – 10.0	2.0 – 10.0

NOTES

(a) Gradation is expressed in percent passing by weight per ASTM C136. Percentage of fines passing No. 200 sieve determined by washing per

ASTM C117.

(b) The alpha portion of the grade designator (SP) represents Superpave mix. The numerical portion (1, 3/4, 1/2, 3/8) represents the ***nominal maximum*** sieve size.

C. **Aggregate Gradation – Marshall Mix Design**: See Table 5. The Target Gradation Curve for the specified aggregate grade must lie within the Master Grading Band limits. The target grading band limits for the Target Grading Curve are the appropriate grading limits for pay factor 1.00 in Table 2. The target grading band limits are allowed to extend outside of the Master Grading Band limits.

Table 5 - Master Grading Band Limits - Marshal Mix Deisgn

Sieve	Aggregate Grades					
	DM-1	**DM-3/4**	**DM-/2**	**OM-1/2**	**FM-1**	**FM-1/2**
1 inch	100					
3/4 inch		100			100	
1/2 inch	75 - 91		100	100	90 - 100	100
3/8 inch		75 - 91		93 - 100	60 - 100	90 - 100
No. 4	47 - 61	46 - 62	60 - 80	36 - 44	15 - 40	30 - 50
No. 8				14 - 21	4 - 12	5 - 15
No. 16	23 - 33	22 - 34	28 - 42			
No. 50	12 - 22	11 - 23	11 - 23			
No. 200	3 - 7	3 - 7	3 - 7	2 - 4	2 -5	2 - 5

NOTES

(a) Gradation is expressed in percent passing by weight, ASTM C136. Percentage of fines passing No. 200 sieve determined by washing, ASTM C117.

(b) Friction Mixture, ASTM D3515.

(c) The alpha portion of the grade designator (DM, OM, FM) represents dense mix, open mix and friction mix. The numerical portion (1, 3/4, 1/2) represents the ***maximum*** sieve size.

D. Design Parameters: Determined by AI MS-2.

Table 6 - Mix Design Parameters					
	SuperPave			**Marshall**	
Compaction Level (b)	50Nd	75Nd	100Nd	50 blow	75 blow
Stability, lbs, minimum (c)	--			1200	1800
Flow, in 0.01 inch units (c)	--			10 - 18	
Design Air Void Target, percent (d)	3.5			3.5	
Voids in Mineral Aggregate (VMA) relative to maximum or nominal sieve size grading and calculated using Gsb(dry), percent, minimm	ASTM D3203			ASTM D6927	
	Nominal Grading			Maximum Grading	
	1		12.0	1	13.0
	3/4		13.0	3/4	14.0
	1/2		14.0	1/2	15.0
	3/8		15.0	3/8	16.0
RAP or ROSP specific gravity for calculations	Gsb (dry) by chemical extraction				
Dust to Binder Ratio, maximum	1.4			1.6	
Tensile Strength Ratio (moisture sensitivity), minimum (e)	-			0.80	
Rutting (Hamburg rut test) (f)	AASHTO T324				
Road Class I	--			--	--
Road Class II	15 mm/10,000 passes			--	--
Road Class III	10 mm/20,000 passes			--	--

NOTES

(a) Road Class is defined in Section 32 01 31.

(b) 100Nd mix is for very high traffic applications only as defined by ENGINEER. 100Nd mix is intended for lower lift applications or surface applications with proactive seal coat program.

(c) Design Density Target: See ASTM D2041. Percent of maximum theoretical specific gravity.

(d) Stability, Flow, Voids: See ASTM D6927.

(e) Tensile Strength Ratio (moisture sensitivity): See ASTM D4867. Use freeze thaw conditioning. Compact test specimen to seven (7) percent plus or minus one (1) percent air voids.

(f) With testing performed at temperatures representing the specified binder grade in the Hamburg rut test, the average rut depth of two (2) mix design test Samples is less than the amount shown for the respective Road Classes.

2.5 SOURCE QUALITY CONTROL

A. Collect Samples randomly, ASTM D3665. Do not change sampling points:
   1. Sampling aggregate, ASTM D75. Collect samples before the drum mixer.
   2. Sampling binder, ASTM D140.
   3. Sampling bituminous paving mixture, ASTM D979.

B. Validate binder grade received from Supplier, Section 32 12 03.

C. Test mix every production day for the following:
   1. Combined aggregate gradation in the mix, ASTM D5444.
   2. Binder content in the mix, ASTM D6307.
   3. Temperature of mix placed in the transport vehicle at the production plant.
      a. Asphalt Binder mixes.
         1) Hot Mix: 325 deg F maximum.
         2) Warm Mix: 325 deg F maximum.
      b. Bitumen Binder mixes or Blended Binder mixes.
         1) Hot Mix: NOT ALLOWED.
         2) Warm Mix: 230 degrees maximum.

D. Warm Mix Testing: When rutting or moisture susceptibility tests are required on plant produced warm mix, condition the warm mix material before testing for two (2) hours at 275 plus or minus five (5) deg F per AASHTO R30 (short term aging). The material may be cooled to room temperature before conditioning.

PART 3 EXECUTION

3.1 CONSTRUCTION EQUIPMENT

A. Mixing Plant: ASTM D995. Provide.
   1. Positive means to determine the moisture content of aggregate.
   2. Positive means to sample all material components.
   3. Sensors to measure the temperature of the mix at discharge.
   4. Ability to maintain discharge temperature of mix.
   5. Capability of maintaining plus or minus five (5) percent tolerance on component percentages in final mix.
   6. Oil Sand Introduction System: **Do not burn off the light oils in Bitumen Binder (oil sand).**

3.2 **INSTALLATION**

A. Pavement placement, Section 32 12 16.13.

B. Pavement restoration, Section 33 05 25

END OF SECTION

SECTION 32 12 13.13
TACK COAT

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Application of asphaltic material to existing bituminous concrete or Portland cement concrete surfaces before placing an bituminous concrete pavement.

1.2 SUBMITTALS

A. Certificate showing asphaltic material complies with Section 32 12 03:

1. Identify water/asphalt dilution ratio.
2. Identify tack coat application rate.

B. Identify asphalt material recommended by fabric manufacturer.

1.3 WEATHER

A. Apply tack coat only when air and roadbed temperatures in the shade are greater than 40 deg F Temperature restrictions may be waived only with ENGINEER's concurrence.

B. Do not apply tack coat during rain, fog, dust, or other unsuitable weather. Do not apply coat to wet surfaces.

1.4 NOTICE

A. Send written notice to residents or business owners 24 hours before applying coat.

PART 2 PRODUCTS

2.1 ASPHALT MATERIAL

A. Select from the following:

1. Emulsified Asphalt: Grade MS-1, SS-1 or SS-1h, Section 32 12 03.
2. Cationic Emulsified Asphalt: Grade CSS-1 or CSS-1h, Section 32 12 03.
3. Rapid Cure Cutback Asphalt: Grade RC-70, Section 32 12 03.

PART 3 EXECUTION

3.1 PREPARATION

A. Select and advise ENGINEER of the type of tack material to be used.

B. Clean surface to be treated free of dust and other foreign material. If flushed, allow surface to dry. If leaves from trees, blow clean.

C. Provide safe pedestrian access across tack coat.

D. Prevent pedestrians, vehicles, pets, etc., access to tack surfaces.

3.2 APPLICATION

A. General:

1. Triple coverage by spray bar required. Stop application if any nozzle is not working properly.
2. Apply tack only to area covered with bituminous concrete in the same day.

B. Application Rate: Typically as follows:

1. Emulsions, 0.05 to 0.15 gallons per square yard.
2. Cutback, CONTRACTOR's choice.

C. Tack for Fabric Application: Comply with manufacturer's recommendation. If none, then as follows:

1. Dry pavement surface, 0.20 to 0.30 gallons per square yard. Within street intersections, on steep grades and in zones where vehicle speed changes are commonplace reduce application rate to no less than 0.20 gallons per square yard.
2. Heavy duty fabrics, 0.30 to 0.40 gallons per square yard.

3.3 PROTECTION

A. Protect all surfaces exposed to public view from being spattered or marred. Remove any spattering, over-coating, or marring.

B. Do not discharge bituminous material into borrow pits or gutters.

3.4 OPENING TO TRAFFIC AND MAINTENANCE

A. Do not permit traffic to travel over the tacked surface until bituminous tack coat has cured or is not picked up by traffic.

B. If detours cannot be provided, restrict operations to a width suitable at least for one-way traffic over the remaining portion of the road.

C. If one-way traffic is provided, control traffic appropriately.

END OF SECTION

SECTION 32 12 13.19
PRIME COAT

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Application of liquid asphalt to aggregate base before placing bituminous concrete or Portland cement concrete pavement.

B. Placing sand on areas that are over-primed.

1.2 SUBMITTALS

A. Certificate showing asphaltic material complies with Section 32 12 03.

1.3 WEATHER

A. Apply prime coat only when air and roadbed temperatures in the shade are greater than 40 deg F Temperature restrictions may be waived only with ENGINEER's knowledge.

B. Do not apply prime coat during rain, fog, dust, or other unsuitable weather.

PART 2 PRODUCTS

2.1 ASPHALT MATERIAL

A. Select from the following:

1. Slow Cure Cutback Asphalt: Grade SC-70, or SC-250, Section 32 12 03.
2. Medium Cure Cutback Asphalt: Grade MC-30, MC-70, or MC-250, Section 32 12 03.
3. Rapid Cure Cutback Asphalt: Grade RC-1, RC-2, or RC-250, Section 32 12 03.

2.2 SAND

A. Clean natural aggregate passing the No. 4 sieve and retained on the No. 200 Sieve.

PART 3 EXECUTION

3.1 PREPARATION

A. If aggregate base course to be primed contains an appreciable amount of loose material or is excessively dusty; moisten, blade, roll, and recompact to make the surface dense.

B. Do not start priming until all free surface moisture has disappeared.

C. Notify residents and business owners 24 hours before applying prime coat.

D. Provide pedestrian access across prime coat if required.

3.2 APPLICATION

A. If pavement surface is to be applied over loosely bonded surface, apply prime coat at 0.10 to 0.50 gallons per square yard to penetrate and seal. Do not flood surface.

B. Cure and dry as long as necessary to attain penetration and evaporation of volatile.

C. Blot over-primed surface with a light, uniform layer of sand.

D. Prime under-primed areas with additional asphalt.

3.3 PROTECTION

A. Protect all structures, including curb, gutter, sidewalks, guardrails and guide posts from being spattered or marred. Remove any spattering, over-coating, or marring at no additional cost to OWNER.

B. Do not discharge bituminous material into borrow pits or gutters.

C. Prevent tracking of prime coat onto adjacent surfaces.

3.4 OPENING TO TRAFFIC AND MAINTENANCE

A. Do not permit traffic to travel over freshly primed surface until prime coat has cured. If detours cannot be provided, restrict operations to a width suitable at least for one-way traffic over the remaining portion of the road. If one-way traffic is provided, control traffic by flagging or pilot car operation.

B. After prime coat application, leave work area undisturbed. If prime coat is tacky or tends to pick up under traffic after four (4) hours, blot excess prime coat with blotter sand. Prime coats can be opened to traffic after blotting.

C. Clean and maintain primed surfaces until surface pavement course is placed. Maintenance includes spreading any necessary additional blotter material, replacing all portions of prime coat that have been destroyed, and patching any break in primed surfaces.

END OF SECTION

SECTION 32 12 16.13
PLANT-MIX BITUMINOUS PAVING

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Place a bituminous concrete pavement base course, leveling course, surface course, overlay course, or an inlay course.

1.2 REFERENCES

A. **AASHTO Standards**:

R9 Acceptance Sampling Plans for Highway Construction.

TP68 Bulk Specific Gravity and Density of Compacted Asphalt Mixtures Using Automatic Vacuum Sealing Method.

T324 Hamburg Wheel-Track Testing of Compacted Hot-Mix Asphalt (HMA).

B. **ASTM Standards**:

D979 Sampling Bituminous Paving Mixtures.

D1188 Bulk Specific Gravity and Density of Compacted Bituminous Mixtures Using Coated Samples.

D2041 Theoretical Maximum Specific Gravity of Bituminous Paving Mixtures.

D2725 Bulk Specific Gravity and Density of Non-Absorptive Compacted Bituminous Mixtures.

D2950 Density of Bituminous Concrete In Place by Nuclear Method.

D3549 Thickness or Height of Compacted Bituminous Paving Mixture Specimens.

D3665 Random Sampling of Construction Materials.

D5361 Sampling Compacted Bituminous Mixtures for Laboratory Testing.

D6927 Marshall Stability and flow of Bituminous Mixtures.

1.3 DEFINITIONS

A. Must Grind: Defined in Section 32 01 31.

B. Road Class: Defined in Section 32 01 31

1.4 SUBMITTALS

A. **Before Delivery**: Submit 48 hours before delivery:

1. Location and name of bituminous concrete production facility.
2. Mix design method.
3. Mix identification number or code.

4. Type, grade, and weight of binder.
5. Type, grade, and weight of aggregate.
6. Traffic control plan, Section 01 55 26.
7. Type and number of rollers.
8. Manufacturer's certificate of compliance for paving geotextiles. (Refer to Section 31 05 19).
9. Certification of profilograph and profilograph operator.
10. Cold weather paving plan.

B. **At Delivery**: For each batch delivered to site identify:

1. Date and project description.
2. Producer and plant.
3. Name of contractor.
4. Serial number of ticket.
5. Mix identification number or code.
6. Truck number and time dispatched.
7. Volume of mix delivered.

C. **After Placement**: Before final payment submit summary report describing profile deviation and profile roughness. See Section 32 01 31.

1.5 .**QUALITY ASSURANCE**

A. Do not change aggregate source or binder grade until ENGINEER accepts new source and new mix design.

B. Reject product and work that does not meet requirements of this Section.

C. Remove product found defective after installation and install acceptable product at no additional cost to OWNER.

D. Foreman of paving crew has completed at least three (3) projects of similar size and nature.

E. If requested, submit a quality control and testing report describing source and field quality assurance activities performed by CONTRACTOR and Suppliers.

F. For all equipment and hand tools used to mix, haul, and place the bituminous concrete, use a release agent that does not dissolve asphalt and is acceptable to ENGINEER.

1.6 **WEATHER**

A. Temperature:

1. April 15 to October 15: Place pavement when air temperature in the shade and the roadway surface temperature are above 50 deg F. The ENGINEER determines may provide written approval if it is acceptable to place outside of this temperature limit.
2. Before April 15 and After October 15: Provide a Cold Weather Paving Plan. ENGINEER must accept the plan before proceding.

Include the following details.

a. Haul details.

b. Placement details.

c. Compaction aids used in production.

d. Coordination procedure for acceptance testing.

B. Moisture: Do not place on frozen base, during adverse climatic conditions such as precipitation, or when roadway surface is wet or icy.

1.7 **NOTICE**

A. Follow Laws and Regulations concerning when and to whom notices are to be given. Send written notice at least three (3) days before start of paving.

B. Indicate paving time and when new surface can be used.

C. Warn of potential vehicle tow away and other construction issues affecting neighborhood.

D. Should work not occur on specified day, send a new notice.

1.8 **ACCEPTANCE**

A. **General**:

1. Acceptance is by Lot.

2. If non-complying material has been installed and no price for the material is specified, apply pay adjustment against cost of work requiring complying material as part of its installation, Section 01 29 00.

3. Dispute resolution, Section 01 35 10.

4. Opening a paved surface to traffic does not constitute acceptance.

5. Observation of CONTRACTOR's field quality control testing does not constitute acceptance. Such testing; however, may be used by ENGINEER for acceptance if requirements of Section 01 35 10 are met.

B. **Mix Material**: Accepted as specified for bituminous concrete , Section 32 12 05, or rubberized asphalt concrete, Section 32 12 08.

C. **Mix Temperature at Site:**

1. Reject mixes in the transport material exceeding the following temperatures.

a. Hot mix, 425 deg F.

b. Warm mix, 300 deg F.

c. Oil sand bituminous concrete, 230 deg F.

2. Dispose of cold mix in paver hopper as thin spread underlay.

D. **Grade, Cross Slope**: Verify tolerances are not exceeded.

E. **Compaction**: Options for acceptance are 1) core density, 2) non-destructive test density, or 3) control strip density with visual observation. Use core density unless specified elsewhere. A Lot is acceptable if density tests are within pay factor 1.00 limits. At ENGINEER's discretion, a Lot with deficient sub-lot density tests may be accepted if pay is adjusted using an applicable pay factor in the following table, or accepted at 50 percent pay if a sub-lot is in Reject.

Table 1 – Compaction Pay Factors		
Pay Factor	**Density, in Percent Relative to ASTM D2041**	
	Average	**Lowest Test**
0.70	More than 96	–
1.00	**92 to 96**	**89 or greater**
0.90	92 to 96	Less than 89
0.80	Less than 92	89 or greater
Reject	Less than 92	Less than 89

1. **Core Density**: This method compares the average density of cores extracted from a pavement surface to maximum theoretical density:
   a. Lot Size: One (1) day production with 1,000 square yard sub-lots or part thereof.
   b. Sampling Protocol: Use ASTM D3665 to randomly select in each sub-lot at least one (1) surface test location and one (1) longitudinal joint test location. Collect at least two (2) test samples at each test location, ASTM D5361. Samples are full depth or overlay depth in overlay construction.
   c. Testing Protocol: ASTM D2725 for core density and ASTM D2041 (Rice) for maximum theoretical density.
2. **Non-Destructive Density Testing by Gage**:
   a. Lot Size: One (1) day production with 1,000 square yard sub-lots or part thereof.
   b. Sampling Protocol: Use ASTM D3665 to randomly select in each sub-lot at least one (1) surface test location and one (1) longitudinal joint test location.
   c. Testing Protocol: ASTM D2950 (nuclear gage) or AASHTO TP68 (non-nuclear gage) and ASTM D2041 (Rice) for maximum theoretical density.
3. **Control Strip Density with Visual Observation**:
   a. Lot: One (1) day production.
   b. Sampling Protocol: Not required after rolling pattern is determined.
   c. Testing Protocol: ASTM D6927 (Marshall) and D2041 (Rice method) to determine rolling pattern for 94 percent compaction, thereafter visual examination.
4. **Compaction Dispute Resolution**:

a. CONTRACTOR:

1) Provide an Independent Testing Agency, Section 01 45 00.

2) Take two (2) supplement cores midway between deficient acceptance test locations, and midway between a deficient test location and an adjacent acceptable test location.

3) Patch core holes.

4) Conduct testing at no additional cost to OWNER.

b. ENGINEER:

1) Accept Lot at full pay if new information shows compliance, or

2) Accept Lot at pay reduction using new test information, or

3) Reject Lot.

F. **Thickness**: A Lot is acceptable if test deficiencies are within pay factor 1.00 limits. At ENGINEER's discretion, a Lot with sub-lot deficiencies greater than allowed for pay factor 1 in the following table may be accepted if pay is adjusted using one of the following applicable pay factors, or accepted at 50 percent pay if a sub-lot is in Reject.

Table 2 – Thickness Pay Factor

Pay Factors	Deficiency Limits, in Inches
1.00	0.00 to 0.375
0.90	0.376 to 0.50
0.70	0.51 to 0.75
Reject	0.76 to 1.00

1. **Lot Size**: One (1) day production with 1,000 square yard sub-lots or part thereof.

2. **Sampling Protocol**: Use ASTM D3665 to randomly select at least one surface test location and one longitudinal joint test location in each sub-lot. Collect at least two (2) core samples at each test location, ASTM D5361. Samples are full depth. Overlay construction measured only on overlay portion of core sample.

3. **Testing Protocol**: ASTM D3549:

a. Minimum Specified Thickness: A Lot specified to have minimum thickness will be accepted if all sub-lot measurements meet or exceed minimum. If thickness is deficient, additional material may be placed over the deficient thickness if there is no pavement feathering; placement matches this section's thickness tolerance; surface continues to drain; and roughness tolerance is met.

b. Actual Specified Thickness: A Lot specified to have actual thickness is acceptable if any sub-lot measurement does not exceed deficiency limits for thickness pay factor 1.00.

4. **Thickness Dispute Resolution**:
   a. CONTRACTOR:
      1) Hire an Independent Testing Agency, Section 01 45 00.
      2) Take two (2) additional cores midway between deficient acceptance test locations, and midway between a deficient test location and the next adjacent acceptable test location.
      3) Patch core holes.
      4) Conduct testing at no additional cost to OWNER.
   b. ENGINEER:
      1) Graph deficient areas by plotting new cores and original cores to define deficient areas assuming the following.
         a) The graph represents the thickness of the pavement.
         b) Thicknesses vary linearly along the pavement length from core depth to core depth.
         c) The pavement is a constant depth in the transverse direction.
      2) Accept Lot at full pay if new information shows compliance, or
      3) Accept Lot at pay reduction using new test information, or
      4) Reject Lot.

G. **Profile Roughness and Profile Deviation**: Section 32 01 31.

1.9 **WARRANTY**

A. Joints at Street Fixtures and Portland Cement Concrete Flat Work: If wider than 1/2 inch before end of the correction period seal joints with asphalt rubber or rubberized asphalt; Section 32 01 17.

PART 2 PRODUCTS

2.1 **MATERIALS**

A. Bituminous concrete, Section 32 12 05.
B. Rubberized asphalt concrete, Section 32 12 08.
C. Tack coat, Section 32 12 13.13.
D. Prime coat, Section 32 12 13.19.
E. Paving geotextile, Section 31 05 19.
F. Paving geogrid, Section 31 05 21.

PART 3 EXECUTION

3.1 CONSTRUCTION EQUIPMENT

A. Paver Machine: Use track equipment when operating on fabrics, geogrids or pavement mats hotter than 180 deg F

B. Compactors: Steel wheel static or vibratory. Use pneumatic tire roller for intermediate rolling only.

3.2 PREPARATION

A. General:

1. Locate and preserve utilities Section 01 31 13. Contact utility companies and other agencies, for dangerous concentration of combustible, flammable, or explosive matter.
2. Lower Street Fixtures if paving machine is not capable of passing over the fixtures.
3. Remove vegetation from cracks, edges and joints. Sweep surface clean. Blow cracks clean. Remove leaves.
4. Fill cracks and fix Potholes, Section 32 01 17.
5. Stabilize Portland cement concrete subgrade slabs.

B. Traffic Control:

1. Implement notification and traffic control plan requirements, Section 01 55 26. Do not proceed without certified flaggers.
2. Apply temporary lane marking tape or paint after layout has been verified with ENGINEER.

C. Aggregate Base Course:

1. Verify base course is placed to grade, compacted and dampened.
2. If indicated, follow Section 31 31 19 requirements for herbicide treatment or Section 32 12 13.19 for prime coat applications.

3.3 PROTECTION

A. Trees, Plants, Ground Cover:

1. Protect trees, plants and other ground cover from damage.
2. Prune trees to allow equipment passage underneath, Section 32 01 93. Repair tree damage at no additional cost to OWNER.

B. Protect all structures, including curb, gutter, sidewalks, guard rails and guide posts from physical damage. Remove spatter, over-coat, or mar.

C. Do not discharge bituminous materials into borrow pits or gutters.

D. Protect hot pavement from traffic until cool enough not to become marred.

E. Remove saw-cut dust immediately. Protect neighborhood, storm drains and down-stream fish habitat.

3.4 TEMPORARY SURFACING

A. Place, roll, maintain, remove and dispose of temporary Pavement surfaces.

B. In sidewalk areas construct temporary pavements at least 1 inch thick and in all other areas at least two (2) inches thick. At major intersections and other critical locations a greater thickness may be required.

3.5 LINE AND GRADE CONTROL

A. Provide necessary survey stakes for horizontal and vertical control.

B. Furnish, place, and maintain supports, wire devices, and materials as required to provide continuous line and grade reference controls for placing pavement, matching existing pavement surfaces, etc.

3.6 FABRIC PLACEMENT

A. Section 31 05 19.

3.7 PAVEMENT PLACEMENT

A. General:

1. Barricade off or eliminate fall off edges.
2. Provide continuous forward paver movement so temperature 10 feet behind paver is as follows:
   a. Warm Mix Placement: 200 deg F minimum.
   b. Hot Mix Placement:

Table 3 – Minimum Pavement Temperature in Degrees F.

Air Temperature Deg F	Compacted Mat Thickness					
	3/4"	1"	1-1/2"	2"	3"	4"+
45 – 50	–	–	–	–	280	265
50 - 59	–	–	–	280	270	255
60 - 69	–	–	285	275	265	250
70 - 79	285	285	280	270	265	250
80 - 89	280	275	270	265	260	250
90 +	275	270	265	260	250	250

B. Overlays or Subsequent Lifts:

1. Allow new base pavement or new inlay pavement to cure (harden) before placing overlays.
2. Apply tack coat per Section 32 12 13.13 if inlay or sub-base Pavement surface is dirty or older than 24 hours.

C. Irregular Areas: Handwork is acceptable if specified grade, slope, compaction and smoothness are achieved.

D. Compaction:

1. Test mix placement until a compaction pattern is acceptable to CONTRACTOR. Continue random quality control testing.
2. Do not over compact or under compact.

3. Complete compaction before the following temperature are reached:
   a. 180 deg F for hot mixes.
   b. 140 deg F for warm mixes.

E. Joints:
1. Construct joints to industry standards for texture, density and smoothness.
2. Clean contact surfaces and apply tack coat. Ensure continuous bond between old and new pavements, or between successive day's work.
3. Offset longitudinal joints a minimum of 12 inches in succeeding courses and at least six (6) feet transversely to avoid a vertical joint through more than one course. In the top course restrict longitudinal joint to 1 foot either side of lane lines.
4. Prevent traffic, including construction traffic, from crossing vertical edges. Apply tack coat to vertical edges before making another pass with paver if mix has cooled to 90 deg F

3.8 TOLERANCES

A. Compaction: Target is 94 percent of ASTM D2041 (Rice density) plus or minus two (2) percent.

B. Lift Thickness: If not indicated, meet the following tolerances.

Table 4 – Lift Thickness Tolerance

Mix Design Method	Minimum	Maximum
Marshall	2 times maximum aggregate size	Not more than limits established by manufacturer of compactor equipment
Performance Grade (Superpave)	4 times *nominal* aggregate size	
NOTES (a) Thickness is measured after compaction.		

C. Smoothness:
1. Parallel to Centerline: Section 32 01 31.
2. Cross Slope: 1/4 inch in 10 feet except at cross section grade breaks.

3.9 REPAIR

A. Repair ride disturbing or unsafe butt joints. Repair expense is at no additional cost to OWNER.

B. If pavement smoothness is deficient, follow Section 32 01 31 repair requirements.

C. Corrective Action for Profile Deviations (“Must Grinds”): Grinding is acceptable. See Section 32 01 26. Apply a fog seal over grind areas. See Section 32 01 13.50. If depressions cannot be corrected by grinding, remove and replace.

D. Corrective Action for Profile Roughness Index: Grinding is acceptable. Re-profile corrected segments to verify ride index meets tolerance. Apply a fog seal over grind areas. See Section 32 01 13.50.

E. When thickness is deficient, place additional material over deficient areas. DO NOT skin patch. Mill for inlay if necessary.

F. Defective Joints, Seams, Edges: Repair.

G. Unacceptable Paving: Remove and replace.

3.10 **OPENING TO TRAFFIC**

A. Temperature of pavement surface is not more than 180 deg F

END OF SECTION

SECTION 32 12 16.18
RECYCLE BITUMINOUS PAVEMENT

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Make a base, leveling, or surface course using an existing bituminous concrete that is in-place.

B. Mix design requirements.

1.2 REFERENCES

A. **ASTM Standards**:

D2950 Density of Bituminous Concrete In Place by Nuclear Method.

D3549 Thickness or Height of Compacted Bituminous Paving Mixture Specimens.

1.3 DEFINITIONS

A. **RAP**: Acronym for reclaimed asphalt pavement. Refer to Section 32 12 05.

B. **RAC**: Acronym for recycled asphalt concrete. A bituminous mix product consisting of RAP or ROSP, new aggregates and Binder or Binder with a recycle rejuvenating agent, the mixture of which creates a new bituminous concrete.

C. **ROSP**: Acronym for reclaimed Oil Sand pavement. Refer to Section 32 12 05.

1.4 SUBMITTALS

A. Before commencing work of this Section, submit:

1. Traffic control plan, Section 01 55 26.
2. A list of equipment to be used.
3. Type of Binder to be used, Section 32 12 03.

B. RAC Mix Design: Determine conditions and properties of existing materials. Identify recycling agent and submit the following data as applicable:

1. If RAP or ROSP is 15 percent or less of the RAC, submit a mix design formula if Supplier does not have a mix design formula at the plant. The formula shall be based on current test data.
2. If RAP or ROSP added to the RAC is over 15 percent, submit a mix design formula.

C. RAC Delivery Tickets, Section 32 12 16.19.

1.5 QUALITY ASSURANCE

A. Section 32 12 16.13.

1.6 **WEATHER**

A. Section 32 12 16.13.

1.7 **NOTICE**

A. Section 32 12 16.13.

1.8 **ACCEPTANCE**

A. Section 32 12 16.13.

PART 2 PRODUCTS

2.1 **MATERIAL**

A. Recycle asphalt (RA), Section 32 12 03.

B. Tack coat, Section 32 12 13.13.

C. Paving geotextile, Section 31 05 19.

D. Paving geogrid, Section 31 05 21.

E. RAP OR ROSP: Free of detrimental quantities of deleterious materials. Graded (on a non-dried basis) as follows.

Sieve	Percent Passing by Weight
1–1/2"	100
1"	90

PART 3 EXECUTION

3.1 **CONSTRUCTION EQUIPMENT**

A. Laydown Machine: Provide track equipment when operating on fabrics or geogrid, otherwise type of equipment is CONTRACTOR's choice.

B. Compactors: Steel wheeled static or vibratory.

3.2 **PREPARATION**

A. General:

1. Locate and preserve utilities, Section 31 23 16. **Contact utility companies and other agencies, for dangerous concentration of combustible, flammable, or explosive matter.**
2. Lower Street Fixtures if pavement recycler machine is not capable of releasing pavement-cutting mechanism to protect fixtures.
3. Remove plant materials from cracks, edges and joints. Sweep surface clean. Blow cracks clean.
4. Stabilize concrete subgrade slabs.
5. Apply tack coat, Section 32 12 13.13.
6. Verify surfaces are dry.

B. Trees, Plants, Ground Cover:

1. Protect trees, plants and other ground cover from damage.
2. Prune trees, Section 32 01 93 to allow equipment passage underneath. Repair tree damage at no additional cost to OWNER.

C. Traffic Control:

1. Control pedestrian and vehicular traffic, Section 01 55 26.
2. Protect pavement from traffic until mixture has cooled enough not to become marked.
3. Apply temporary lane marking tape or paint after layout has been verified with ENGINEER.

D. Milling, Section 32 01 16.71

3.3 PLACING RAC

A. Hot-laid RAC, Section 32 12 16.13

B. Cold-laid RAC, Section 32 12 16.19

C. Mix and blend milled aggregate, recycling asphalt, virgin asphalt and virgin aggregate per mix design.

3.4 TOLERANCES

A. Compaction, lift thickness, grade, cross slope, Section 32 12 16.19

B. Complete compaction of RAC within five (5) minutes of placing RAC and before its temperature drops below 200 deg F

3.5 PROTECTION AND REPAIR

A. Section 32 12 16.19.

END OF SECTION

SECTION 32 12 16.19

COLD-MIX BITUMINOUS PAVING

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Construct a bituminous concrete pavement base course, leveling course, or surface course by placing a bitumen cement over an in-place aggregate and mixing and compacting the product in-place.

B. Bituminous concrete material is not specified in this section. Refer to Section 32 12 05.

1.2 REFERENCES

A. **ASTM Standards**:

D1461 Moisture or Volatile Distillates in Bituminous Paving Mixtures.

D2041 Theoretical Maximum Specific Gravity of Bituminous Paving Mixtures.

D2170 Kinematic Viscosity of Asphalts (Bitumens).

D2399 Selection of Cutback Asphalts.

D3628 Selection and Use of Emulsified Asphalts.

D5581 Resistance to Plastic flow of Bituminous Mixtures Using Marshall Apparatus (6 inch-Diameter Specimen).

1.3 SUBMITTALS

A. Traffic control plan, Section 01 55 26.

B. Laboratory mix design, Section 32 12 05.

C. Batch Delivery Tickets: Submit ticket for each batch delivered to the work site. Include information specified in Section 32 12 16.13.

1.4 WEATHER

A. Section 32 12 16.13.

1.5 NOTICE

A. Section 32 12 16.13

1.6 ACCEPTANCE

A. Section 32 12 16.13.

PART 2 PRODUCTS

2.1 MATERIALS

A. Bituminous Binder: Emulsified asphalt or medium curing cutback asphalt, Section 32 12 03. If type is not indicated CONTRACTOR is to select the material recommended in the following ASTM standards.

1. Emulsified asphalt, ASTM D3628.
2. Cutback asphalt, ASTM D2399.

B. Aggregate, Section 32 12 05: Use an aggregate containing not more than two (2) percent moisture. If more, dry before applying bituminous product. An exception may be made for unusually porous material, when laboratory tests indicate excess moisture will not produce an unstable mix.

PART 3 EXECUTION

3.1 CONSTRUCTION EQUIPMENT

A. Lay-down Machine: Use track equipment when operating on fabrics or geogrid.

B. Compactors: Steel wheeled static or vibratory. Use a pneumatic tire roller for intermediate rolling only.

3.2 PREPARATION

A. Trees, Plants, Ground Cover:

1. Protect trees, plants and other ground cover from damage.
2. Prune trees, Section 32 01 93 to allow equipment passage underneath. Repair tree damage at no additional cost to the OWNER.

B. Traffic Control:

1. Provide worker and public safety, Section 01 55 26.
2. Apply temporary lane marking tape or paint after layout has been verified with ENGINEER.

3.3 PREPARATION OF AGGREGATE

A. On unpaved surfaces, prime coat whole roadway surface receiving cold-mix application, Section 32 12 13.19.

B. Place aggregate on the prepared base in a uniform windrow or windrows.

C. Notify ENGINEER 48 hours in advance of applying bituminous material to permit check of aggregate with respect to volume, moisture content, unit weight, and proper amount of bituminous material to be used.

3.4 PROPORTIONING AND MIXING

A. Unless specified otherwise, method of mixing may be traveling mixer method, stationary mixer method, or blade mixing method.

B. Traveling Mixer Method:

1. Accomplish mixing by means of mixer that will thoroughly blend aggregate and bitumen. Use metering devices that will accurately introduce required quantity of bitumen during the mixing process. Produce a satisfactory mixture that is uniform in appearance, texture and bitumen content, free from pockets of segregated aggregates.

2. When necessary, supplement travel plant mixing with blade mixing to obtain desired degree of aeration of mix. Continue mixing until not more than 50 percent of original volatiles present in the bituminous material remain in the mix, ASTM D1461.

C. Blade Mixing Method:

1. Spread and windrow aggregate on the prepared base, after that, uniformly apply bituminous material over the aggregate.

2. Apply bituminous material in two (2) or more applications over a section of definite limits. Limit amount of bitumen spread in any 1 application to 0.50 gallon per square yard. Exercise care to avoid overlapping of spreads onto adjoining sections. Immediately after each application, partially mix the bituminous material with the aggregate.

3. After the last application of bituminous material and partial mixing, windrow the entire mass of bitumen and aggregate and mix by blading material from side to side of roadway. Blade to produce a satisfactory mixture that is uniform in appearance, texture, and bitumen content, and free from pockets of segregated aggregates and continue until not more than 50 percent of original volatiles present in the bitumen remain in the mix, ASTM D1461. While mixing, take care to avoid cutting into underlying base course or contaminating the bituminous mixture with earth or other foreign matter.

D. Stationary Mixing Method:

1. Dry aggregate to optimum moisture content before mixing. Use same application of bituminous material and mixing as required for traveling mixer.

2. After mixing, haul and place mix on the roadway surface in windrows. All requirements as to uniformity, percent of volatiles, and textures are as required for traveling mixer that may require supplemental blade mixing.

3.5 TEMPERATURE CONTROL

A. Maintain temperature range of cold road mix material at time of application so viscosity will be between 50 and 200 centistokes, ASTM D2170.

3.6 PLACING PAVEMENT MIXTURE

A. When mixing has been completed, spread mixture in such a manner that the finished surface conforms to the elevations, grades, and cross-sections indicated.

B. At the end of each day's work or when the work is interrupted by adverse weather conditions, blade all loose material into a windrow, whether mixing is completed or not. Do not leave material spread on the roadbed overnight.

3.7 TOLERANCES

A. Section 32 12 16.13.

3.8 PROTECTION AND REPAIR

A. Section 32 12 16.13.

END OF SECTION

SECTION 32 13 13
CONCRETE PAVING

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Place Portland cement concrete in a base course, surface course, overlay course, or an inlay course.

B. This specification does not apply to concrete flat work.

1.2 REFERENCES

A. **ACI Standards**:

305 Hot Weather Concreting.

306 Cold Weather Concreting.

318 Building Code Requirements for Reinforced Concrete.

B. **APWA (Utah) Standards**:

Plan 261 Concrete pavement joints.

C. **ASTM Standards**:

A307 Carbon Steel Bolts and Studs, 60,000 psi Tensile Strength.

C39 Compressive Strength of Cylindrical Concrete Specimens.

C78 Flexural Strength of Concrete (Using Simple Beam with Third-Point Loading).

C94 Ready-Mixed Concrete.

C174 Measuring Thickness of Concrete Elements Using Drilled Concrete Cores.

C231 Air Content of Freshly Mixed Concrete by the Pressure Method.

C1315 Liquid Membrane-Forming Compounds Having Special Properties for Curing and Sealing Concrete.

D3665 Random Sampling of Construction Materials.

D5249 Backer Material for Use with Cold- and Hot-Applied Joint Sealants in Portland-Cement and Asphalt Joints.

E950 Measuring the Longitudinal Profile of Traveled Surfaces with an Accelerometer Established Inertial Profiling Reference.

E1274 Measuring Pavement Roughness Using a Profilograph.

D. **DOT Standards**:

1. Publication No. HIF-07-004: Integrated Materials and Construction Practices for Concrete Pavement.

1.3 DEFINITIONS

A. Must Grind: Defined in Section 32 01 31.

B. Road Class: Defined in Section 32 01 31

1.4 SUBMITTALS

A. **Before delivery**: Submit 48 hours before delivery:

1. Traffic control plan, Section 01 55 26.
2. Joint layout plan.
3. Concrete placement plan. Identify items such as but not limited to grade control system, placement start and stop timing, hydration control during cold conditions (ACI 306), hot and windy conditions (ACI 305), timing for evaporation retarder application, timing for curing agent application, floating restrictions, concrete saw-cut timing, header joints.
4. Curing plan. Describe method to prevent excessive concrete temperatures and water evaporation that could impair strength or serviceability of concrete. Refer to ACI 305.
5. Evaporation Retarder Data Sheet. Identify product components, application, and manufacturer's recommendations.
6. Proof of finisher's ACI certification.
7. Make and model name of paving machine, grade trimmer, and gang drill mechanism.
8. Pre-approved concrete mix design or supplier's mix number, Section 03 30 04.
9. Certification of profilograph calibration and profilograph operator.
10. Manufacturer's recommended installation procedures for joint sealing material which, when accepted by ENGINEER, will become the basis for accepting or rejecting actual installation procedures used in the Work.

B. **At Delivery**: Submit batch ticket, Section 03 30 10.

C. **After Placement**: Before final payment submit summary report describing profile deviation and profile roughness. See Section 32 01 31 requirements.

1.5 QUALITY ASSURANCE

A. Do not change concrete supplier until ENGINEER accepts new source and new mix design.

B. Reject product that does not meet requirements of Section 03 30 04.

C. Remove product found defective after installation and install acceptable product at no additional cost to OWNER.

D. Foreman of paving crew has completed at least three (3) projects of similar size and nature.

E. Lead finishing mechanic is ACI certified.

F. Follow state of practice for quality assurance as published in FHWA Publication No. HIF-07-004.

G. If requested, submit a quality control and testing report describing source and field quality assurance activities performed by CONTRACTOR its Suppliers.

1.6 **WEATHER**

A. Hot weather, ACI 305. Set retarding admixture may be used if allowed in mix design. Discontinue placement if ambient air temperature exceeds 100 deg F in the shade.

B. Cold weather, ACI 306 Accelerating admixtures may be used if allowed in mix design. Provide weather protection until 90 percent of design compressive strength is achieved. When removing heat, limit temperature change next to concrete surface to 20 deg F per 12 hours until the concrete surface temperature reaches ambient:

1. Use of admixtures or curing agent will not relax cold weather placement and cure requirements.
2. Do not use chemical additives to prevent freezing.
3 Prevent loss of moisture during protection.

1.7 **NOTICE**

A. Follow Laws and Regulations concerning when and to whom notices are to be given. Send written notice at least three (3) days before start of paving.

B. Indicate paving time and when new surface can be used.

C. Warn of potential vehicle tow away and other construction issues affecting neighborhood.

D. Should work not occur on specified day, send a new notice.

1.8 **ACCEPTANCE**

A. **General**:

1. Acceptance is by Lot. Lot size is one day production and as listed below.
2. If non-complying material has been installed and no price for the material is specified, apply pay adjustment against cost of work requiring material as part of its installation, Section 01 29 00.
3. Dispute resolution, Section 01 35 10 and Section 03 30 05.
4. Opening a paved surface to traffic does not constitute acceptance.
5. Observation of CONTRACTOR's field quality control testing does not constitute acceptance. Such testing; however, may be used by ENGINEER for acceptance if requirements in Section 01 35 10 are met.

B. **Temperature, Slump, Air**:

1. Lot size is one (1) random batch.
2. Testing Frequency: Section 03 30 05.
3. Reject non-complying batches until two (2) consecutive batches are compliant then continue in random batch testing for acceptance.

C. **Strength**: At ENGINEER's discretion, a Lot with deficient sub-lot strength may be accepted if pay is adjusted using one of the following applicable pay factors, or accepted at 50 percent pay if a sub-lot is in Reject.

Table 1 – Strength Pay Factor			
Criteria	**Pay Factor**	**PSI Below 28 day Compressive Strength**	**Lot Size, in Square Yards**
Compression (ASTM C39)	0.98	1 to 100	500
	0.94	101 to 200	
	0.88	201 to 300	
	0.80	301 to 400	
	Reject	Greater than 400	
Flexure (ASTM C78)	0.95	1 to 29	750
	0.85	30 to 60	
	Reject	Greater than 60	

1. Strength Dispute Resolution:
   a) CONTRACTOR:
      1) Hire an Independent Testing Agency, Section 01 45 00.
      2) Follow Section 03 30 05 requirements.
      3) Conduct testing at no additional cost to OWNER. Retesting must be completed within 40 calendar days after placement.
   b) ENGINEER:
      1) Accept lot at full pay if average strength of three (3) cores from the defective lot is greater than or equal to 85 percent of compressive strength (f_c'), and if no single strength retest is less than 75 percent of f_c'.
      2) Use original cylinder compressive strengths for pay factor determination if any of above criteria are not met.

D. **Placement**: Section 03 30 10.
   1. Verify grade, cross slope, finish and dimensions.
   2. No standing water in curb and gutter.
   3. Curing membrane applied at twice coverage rate recommended by curing membrane Supplier.

E. **Thickness**: A Lot is acceptable if test deficiencies are within pay factor 1.00 limits. At ENGINEER's discretion, a lot with greater sub-lot deficiencies may be accepted if pay is adjusted using one of the following applicable pay factors, or accepted at 50 percent pay if a sub-lot is in Reject.

Table 2 – Thickness Pay Factor		
Pay Factors	**Deficiency Limits, in Inches**	
	Residential street	**Non-residential street**
1.00	0.00 to 0.25	0 to 1/8
0.90	0.26 to 0.50	1/8 to 1/4
0.75	--	1/4 to 1/2
0.70	0.51 to 0.75	--
0.60	--	1/2 to 3/4
0.50	0.76 to 1.00	--
Reject	Greater than 1.00	Greater than 3/4

1. Lot Size: 1,000 square yards or part thereof.
2 Sampling Protocol: Use ASTM D3665 to randomly select at least one (1) test location in each lot. Collect two (2) samples at each test location. Samples are full depth. Patch core holes.
3. Testing Protocol: ASTM C174.
4. Thickness Dispute Resolution:
   a. CONTRACTOR:
      1) Hire an Independent Testing Agency, Section 01 45 00.
      2) Take two (2) additional cores midway between deficient acceptance test locations, and midway between a deficient test location and the next adjacent acceptable test location.
      3) Patch core holes.
      4) Conduct testing at no additional cost to OWNER.
   b. ENGINEER:
      1) Graph deficient areas by plotting new cores and original cores to define deficient areas assuming the following.
         a) The graph represents the thickness of the pavement.
         b) Thicknesses vary linearly along the pavement length from core depth to core depth.
         c) The pavement is a constant depth in the transverse direction.
      2) Pay Factor: The pay factor will be calculated over the Lot's deficient area or over areas extending into adjacent Lots.
      3) Accept lot at full pay if new information shows compliance, or
      4) Accept Lot at pay reduction using new test information, or
      5) Reject Lot.

F. **Profile Roughness and Profile Deviation**: Verify tolerances required in Section 32 01 31.

PART 2 PRODUCTS

2.1 CONCRETE

A. Compression Design: Class 4000, Section 03 30 04. Slump per mix design.

B. Flexure Design:

1. Strength: 650 psi, ASTM C78.
2. Cement Content: 6.5 bags.
3. Water cement Ratio: 0.44 maximum by weight (before pozzolan exchange), ACI 318.
4. Entrained Air: Five (5) to seven (7) percent, ASTM C231 (pressure).
5. Slump per accepted mix design.

2.2 EVAPORATION RETARDER

A. Water based spray-on liquid that forms a mono-molecular film over the plastic concrete surface.

2.3 CONCRETE CURING COMPOUND

A. Type II Class A or B (white pigmented) liquid membrane forming compound, ASTM C1315.

2.4 JOINT MATERIALS

A. Section 32 13 73.

1. Expansion Joint Filler: F1 sheet.
2. Contraction Joint Filler (Backer Rod): Type 1 round, ASTM D5249.
3. Contraction Joint Sealer: HAS1, HAS4, or CAS6.

2.5 STEEL REINFORCEMENT

A. Section 03 20 00.

B. Tie Bar: Grade 60 or higher deformed billet steel bars galvanized or epoxy coated.

C. Dowel Bar: Grade 60 or higher billet steel bar, galvainzed or epoxy coated with plastic expansion cap on one (1) end.

D. Chair and Basket Assemblies: Plastic chairs. Galvanized or epoxy coated grade 60 billet steel bar basket assemblies.

E. Hook Bolts: Galvanized ASTM A307, grade A steel, nuts and shaft internall and externally threaded.

2.6 BOND BREAKER

A. Wax based compound.

2.7 EPOXY ADHESIVE GROUT

A. Two component, Section 03 61 00.

2.8 EVAPORATIVE REDUCER

A. Water-based mono-molecular polymer liquid at application rates recommended by manufacturer. **DO NOT use as a finishing aid**.

PART 3 EXECUTION

3.1 CONSTRUCTION EQUIPMENT

A. **Mixing plant**: ASTM C94, Option C:

1. Use scales certified by the State of Utah. Do not use volume measurement except for water and liquid admixtures.
2. Mixing time must exceed 80 seconds after adding air entrainment admixture.

B. **Cylinder Storage Device**: A container at the work site that maintains an interior temperature of 60 to 80 deg F. equipped with an automatic seven (7) days temperature recorder, accurate within two (2) degrees and having a permanent recording feature. A 24 hours test run may be required. Cease concrete operation when storage capacity of storage device is reached.

C **Concrete Hauling Vehicle**:

1. Truck mixer: Not allowed if ready mix product can be provided. If allowed:
   a. Fill drum no more than 63 percent of the gross drum volume and no less than two (2) cubic yards is occupied.
   b. Use drum manufacturer's recommended mixing speed (between 12 – 18 rpm)
   c. Driver of vehicle has and follows Supplier's manual of standard operational procedures.
2. Truck Agitator: Do not fill drum greater than 80 percent of the gross drum volume. Use drum manufacturer's recommended agitating speed (between 2 – 6 rpm).
3. Dump truck. End dump or side dump is acceptable. Air content must be controlled at the mixing plant.

D. **Trimmer**: A self propelled unit to strike off and shape surface of road base material so future placement of concrete pavement meets specified thickness. The trimmer uses the same line and grade control assembly or system that the paving machine uses.

E. **Slip Form Paving Machine**:

1. Capable of providing one pass between crown line and back of curb unless specified otherwise.
2. Self Propelled with two or four tracks

3. Steering and elevation controlled from reference string lines.
4. Paving width up to 50 feet (depending upon model and attachments).
5. Weight 2,000 pounds per foot of paving lane width.
6. Continuous auger, hydraulic plow-pans, or conveyor system to distribute concrete in front of the screed.
7. Variable speed internal vibrators.
8. Capable of consolidating mats up to 15 inches thick.
9. Various finishing attachments.

F. **Fixed Form Paving Machine:**

1. Capable of providing one pass between crown line and lip of gutter.
2. Ride on forms or on self-propelled wheels.
3. Steering and elevation controlled by fixed forms.
4. Various paving width.
5. Weight about 1,000 pounds per foot of paving width.
6. Suspended screw auger to spread concrete in front of screed or roller.
7. Has one or two vibrators that move transversely in front of the screed. May also use fixed vibrators near the form edges.
8. Capable of consolidating amts up to 10 inches thick.

G. **Vibrating Screed**:

1. Capable of providing one pass between crown line and lip of gutter.
2. Various paving width.
3. Elevation controlled by fixed forms or string-line.

H. **Finishing and Texturing Equipment**.

1. Machine float may be attached to paver.
2. Texturing equipment acceptable to ENGINEER.
3. Curing compound application device with a fully atomizing type power spray and a wind protection hood.

I. **Straight Edge**: 10 to 20 feet long hand-operated. Successive straightedge checks should overlap by one-half the length of the straightedge.

J. **Profilograph**:

1. Capable of producing results required by ASTM E950 and ASTM E1274.
2. Set profilograph readings with corresponding project survey stationing, or as a minimum, correlate equipment station 0+00 with a specific project station number. ENGINEER to select.

3.2 PREPARATION

A. **General**:

1. Locate and preserve utilities, Section 01 31 13. Contact utility companies and other agencies, for dangerous concentration of combustible, flammable, or explosive matter.
2. Lower Street Fixtures if paving machine is not capable of passing over fixtures.
3. Coat surface of Street Fixtures with oil to prevent bond with concrete pavement.
4. Remove sand, leaves and other objectionable materials before placing paving course.
5. Notify ENGINEER at least 24 hours before commencement of concreting operations.

B. **Traffic Control**:

1. Implement notification and traffic control plan requirements, Section 01 55 26. Do not proceed without certified flaggers.
2. Apply temporary lane marking tape or paint after layout has been verified with ENGINEER.

C. **Aggregate Base Course**:

1. Verify base course is placed to grade, compacted and dampened.
2. If indicated, follow Section 31 31 19 requirements for herbicide treatment or Section 32 12 13.19 for prime coat requirement.

D. **Cement Treated or Lean Concrete Base**:

1. Aggregate Subgrade: Moisten surface but do not place concrete over standing water.
2. Concrete Subgrade:
   a. Remove loose material from surface of cement treated or lean concrete base course immediately before placing concrete surface course.
   b. Apply a double coat of bond breaker before placing surface concrete.

3.3 PROTECTION

A. Protect placed concrete, Section 03 30 10 and as follows:

1. Do not allow steel wheel rollers or steel wheel vehicles on the concrete Pavement. Keep traffic and construction equipment off at least 10 days after concrete placement or until 100 percent of the design strength has been achieved and verified by either:
   a) Maturity meter.
   b) Concrete cylinders.
2. If construction traffic is permitted, keep Pavement clean. Remove surface stains and spillage of materials as they occur.
3. Remove saw-cut dust immediately. Protect neighborhood, storm

drains and down-stream fish habitat.

B. Trees, Plants, Ground Cover:

1. Protect trees, plants and other ground cover from damage.
2. Prune trees to allow equipment passage underneath, Section 32 01 93. Repair tree damage at no additional cost to OWNER.

3.4 LINE AND GRADE CONTROL

A. **General**:

1. Furnish, place, and maintain forms, supports, wire devices, and materials as required for providing continuous line and grade control.
2. Use survey staking. Distances between line and grade control points are as follows:
   a. 25 feet maximum on tangent sections.
   b. 10 feet maximum on vertical curve high points and low points, and on horizontal curves from PC to PT points.
3. Provide additional grade control at high points, low points,
4. Check line and grade control immediately before paving operation.
5. Use the same grade control system to control the paver and the grade trimmer.

B. **Slip Form Paving**. Equip machinery with a control system that automatically controls concrete placement to the specified longitudinal grades and transverse cross slopes.

C. **Formed Paving.** Section 03 11 00. Keep forms free from warps, bends, kinks, and equal in depth to the specified pavement edge. Tightly join formed sections and stop paving operation if the side forms to not meet or hold the following line and grade:

1. Top of forms not more than 1/4 inch from true grade.
2. Vertical face on longitudinal axis not more than 1/4 inch from true line.

3.5 REINFORCEMENT PLACEMENT

A. Section 03 20 00.

B. Use smooth dowel in expansion joints.

C. Interrupt reinforcement placement at expansion joints.

D. Keep load transfer bars and dowels in vertical center of concrete and perpendicular to the joint during concrete placement.

E. Position mats on bar chair supports and properly tie before concrete is poured. Keep mats clean, free from rust, flat, and free of distortions. Straighten bends, kinks, and other irregularities or replace units before concrete placement. Provide at least two (2) inch overlap to adjacent mats.

F. DO NOT place the end of a dowel or tie bar within 18 inches of any joint

3.6 JOINTS

A. **General**:

1. Review joint layout with ENGINEER.
2. See APWA Plan 261 for joint types.
3. Do not allow edge slump when placing tie-bars or by over-working edge of slab.
4. If CONTRACTOR chooses to open the roadway to construction or public traffic before final sawing and sealing, install backer rod in the initial (green) cut to prevent entrance of incompressibles.

B. **Contraction Joints (Crack Control Joint):**

1. Joint spacing measured in feet not to exceed twice the slab thickness measured in inches or 15 feet maximum.
2. Joint depth = T/3. T is depth of concrete slab in inches.
3. Use of a mechanical control joint-void former in lieu of saw cutting or tooling is acceptable.
4. Make transverse joints align with end at curb and gutter joints.
5. Leave forms in place until paving operations are resumed on the other side of the joint.
6. Keep a minimum of three (3) working power saws on site when concrete operations are underway. Saw all joints before uncontrolled shrinkage cracking takes place. Do not tear or ravel concrete during sawing.

C. **Expansion Joints**:

1. Joint Filler Type:
   a. Place joint filler vertical in position, in straight lines. Secure fillers to formwork or other to prevent movement. When butted together, do not leave voids or gaps between filler units.
   b. Set joint fillers full depth if no joint sealant is specified. Recess joint fillers if backer rods and joint sealant are specified.
2. Dowel Bar Type:
   a. Provide expansion cap on end of dowel bar.
   b. If a deformed bar is used in an expansion joint, provide sleeve for movement.

D. **Header Joints (Transverse Construction Joints) in Slip Form Paving:** Extend concrete paving placement an addition five (5) feet at the end of a day of work or at an interruption for a bridge, intersection, or leave-out. When hardened, saw cut and remove the five feet to create the header. Install dowels into the hardened concrete and continue concrete placement.

E. **Volunteer Crack Joint**:

1. If a volunteer crack joint falls within five (5) feet of the location of proposed contraction joint, omit the contraction joint.
2. Rout volunteer crack joints to a depth of 1/4 slab thickness per detail 1 of APWA Plan 261. Clean and fill crack joint with backer rod and joint sealant.
3. If a volunteer crack joint develops within two (2) feet of expansion or construction joints, replace panel. Use saw cuts and tie-bars or dowels in cut planes.

F. **Joint Sealing**: Section 32 13 73.

3.7 PLACEMENT

A. Section 03 30 10.

B. Do not place concrete until concrete sub base and surface course forms have been checked for line and grade. Moisten sub base if required to provide a uniform dampened condition at time of concrete placement. Do not place concrete around manholes or other structures until they are at required finish elevation and cross slope.

C. At the beginning of concrete placement:

1. Test slump and air. If corrections are necessary, placement may proceed after two (2) subsequent and consecutive batches pass testing.
2. Tempering, not allowed unless Section 03 30 10 requirements are followed or mix design makes allowance for water addition.
3. Admixtures (such as for air entrainment) not allowed unless specified elsewhere.

D. **Any delay in excess of 15 minutes from placing to start of finishing operations is cause for stopping placement work**.

E. Prevent segregation of mix. Consolidate concrete along face of forms and adjacent to transverse joints with internal vibrator. Keep vibrator away from joint assemblies, reinforcement, or side forms. Use only square-faced shovels for hand-spreading and consolidation. Consolidate with care to prevent dislocation of reinforcing, dowels, and joint devices.

F. Do not place concrete in a longitudinal section until test specimens from the adjacent lane have attained a compressive strength of 2,500 psi as determined by maturity meter or cast cylinders.

G. Deposit and spread concrete in a continuous operation between transverse joints. If interrupted for more than 1/2 hour, place a construction joint.

H. Place the concrete to the full width of the pavement in a single construction operation unless indicated otherwise.

3.8 SCREEDING AND FLOATING

A. Strike-off , consolidate, and provide a smooth surface by screeding

B. After screeding, test slab for trueness with a straight edge. Distribute concrete as required to remove surface irregularities.

C. Apply an evaporation retarder immediately after screeding (or after floating if floating is required). Apply retarder BEFORE bleed water has vanished. **Do not use the retarder as a finishing aid**.

D. Use floating hand methods only where mechanical floating is not possible. Adjust floating to compact surface and produce uniform texture. Refloat repaired areas to provide a continuous smooth finish.

3.9 **FINISHING**

A. Section 03 35 00.

B. DO NOT use steel finishing equipment (floats, trowels, etc.).

C. **Any delay in excess of 30 minutes for completing the finishing operation is cause for stopping concrete placing to correct difficulties**.

D. Round edges of slabs, gutters, back top edge of curb, and formed joints with an edging tool. Eliminate tool marks.

E. Surface Texture: After floating when excess moisture or surface sheen has disappeared:

1. For speed less than 45 mph: 1/16 inch deep burlap drag, turf drag, or broom.

2. For speeds 45 mph and greater: 1/8 inch deep groove placed 80 degrees to center line and randomly spaced between 3/8 and 1-1/2 inches.

F. Do not remove forms for at least 24 hours after concrete has been placed. After form removal, clean ends of joints and patch any minor honeycombed areas. Remove and replace areas or sections with major defects.

3.10 **CURE**

A. Section 03 39 00.

B. Immediately after floating and texturing as the water sheen of the surface is disappearing, apply curing agent in two directions for total white coverage on all exposed surfaces.

C. Apply agent at twice the rate recommended by the compound manufacturer. Applying curing agent too late (after concrete dampness has disappeared) may cause work rejection by ENGINEER.

D. Eliminate thermal shock of concrete by keeping cure temperature close to ground and air temperature.

3.11 **TOLERANCES**

A. **Slab Thickness**: Not more than 1/4 inch deficient.

B. **Smoothness**:

1. Parallel to Centerline: Section 32 01 31.

2. Cross Slope: 1/4 inch in 10 feet except at cross section grade breaks.

C. **Dowel Bar**:

1. Maximum allowable skew is 0.375 inches per 12 inches (3 percent) in the horizontal and vertical planes.
2. Embedment is six (6) inches minimum.
3. Position in slab is center plus or minus 1/2 inch.

3.12 **REPAIR**

A. General: Section 03 30 10. All expenses are at no additional cost to OWNER.

B. Corrective Action for Profile Deviations ("Must Grinds"): Grinding per Section 32 01 26 is acceptable after concrete cure. Apply a water repelling product, Section 07 19 00 over grind surfaces. If depressions cannot be corrected by grinding, remove and replace.

C. Corrective Action for Profile Roughness Index: Grinding is acceptable. Re-profile corrected segments to verify ride index meets tolerance. Apply a water repelling product, Section 07 19 00 over grind areas.

D. Corrective Action for Cracks: Consider repair options published in guidelines by the American Concrete Pavement Association (ACPA). Do not begin corrective work until ENGINEER agrees with repair option. Drill test cores when necessary to determine magnitude. Fill holes with Portland cement concrete bonded to pavement with epoxy adhesive.

3.13 **OPENING TO TRAFFIC**

A. Not less than 3,000 psi compressive or 400 psi flexure strength.

END OF SECTION

SECTION 32 13 73
CONCRETE PAVING JOINT SEALANTS

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Joints and joint sealants in horizontal concrete sidewalks, curb, gutter and roadway Pavement surfaces.

1.2 REFERENCES

A. **ASTM Standards**:

C920 Elastomeric Joint Sealants.

D545 Preformed Expansion Joint Fillers for Concrete Construction (Nonextruding and Resilient Types).

D994 Preformed Expansion Joint Filler for Concrete (Bituminous Type).

D1190 Concrete Joint Sealer, Hot-Poured Elastic Type.

D1191 Testing Concrete Joint Sealers.

D1751 Preformed Expansion Joint Filler for Concrete Paving and Structural Construction (Nonextruding and Resilient Bituminous Types).

D1752 Preformed Sponge Rubber and Cork Expansion Joint Fillers for Concrete Paving and Structural Construction.

D1851 Concrete Joint Sealers, Cold-Application Type.

D2240 Rubber Property - Durometer Hardness.

D2628 Preformed Polychloroprene Elastomeric Joint Seals for Concrete Pavements.

D3405 Joint Sealants, Hot-Poured, For Concrete and Asphalt Pavements.

D3406 Joint Sealant, Hot-Applied, Elastomeric-Type, for Portland Cement Concrete Pavements.

D3407 Testing Joint Sealants, Hot-Poured, For Concrete and Asphalt Pavements.

D3408 Joint Sealants, Hot-Poured, Elastomeric-Type, for Portland Cement Concrete Pavements.

D3542 Preformed Polychloroprene Elastomeric Joint Seals for Bridges.

D3569 Joint Sealant, Hot-Applied, Elastomeric, Jet-Fuel-Resistant-Type for Portland Cement Concrete Pavements.

D3575 Flexible Cellular Materials Made from Olefin Polymers.

D3581 Joint Sealant, Hot-Poured, Jet-Fuel-Resistant Type, for Portland Cement Concrete and Tar-Concrete Pavements.

D3582 Testing Joint Sealant, Hot-Poured, Jet-Fuel-Resistant Type, for Portland Cement Concrete and Tar-Concrete Pavements.

D3583 Joint Sealant, Hot-Applied, Elastomeric Type, for Portland Cement Concrete Pavements, or Joint Sealant, Hot Applied, Elastomeric, Jet Fuel Resistant Type, for Portland Cement Concrete Pavements.

D5249 Backer Material for Use with Cold- and Hot-Applied Joint Sealants in Portland-Cement and Asphalt Joints.

D5893 Cold Applied, Single Component, Chemically Curing Silicone Joint Sealant for Portland Cement Concrete Pavements.

B. **FS Standards**:

SS-S-200 Sealants, Joint, Two Component, Jet-Fuel Resistant, Cold-Applied, for Portland Cement Concrete Pavement.

1.3 SYSTEM PERFORMANCES

A. Pavement joints include longitudinal and transverse expansion joints, contraction joints, construction joints, and crack control joints.

B. Provide joint sealants that maintain watertight and airtight continuous seals.

1.4 SUBMITTALS

A. Manufacturer's certification that product was manufactured, tested and supplied meeting source quality control requirements specified herein, together with a report of the test results and the date each test was completed.

B. Manufacturer's instruction for joint preparation, type of cleaning and installation.

C. Manufacturer's product data and samples for each joint sealant product required.

D. Safety data sheets.

1.5 QUALITY ASSURANCE

A. Installation of joint systems are to follow manufacturer’s published directions.

B. For cold applied joint sealant installation, use installers approved by joint sealant supplier.

C. Obtain joint sealing materials from a single manufacturer for each different product required.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Deliver materials to site in original unopened containers or bundles with labels identifying manufacturer, product name and designation, color, expiration period for use, pot life, cure time, and mixing instructions for

multi-component materials.

B. Store and handle materials in compliance with manufacturer's recommendations to prevent deterioration; or damage due to moisture, high or low temperatures, contaminants, or other causes.

PART 2 PRODUCTS

2.1 GENERAL

A. Compatibility: Provide joint fillers, sealant backings, sealants, 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.

2.2 JOINT VOID - FORMER

A. Plastic with a water stop.

B. 1/4 depth of concrete structural section.

2.3 JOINT FILLER - SHEET TYPE

A. **F-1**: Bituminous (asphalt or tar) mastic, ASTM D994. Formed and encased between two (2) layers of bituminous saturated felt or two (2) layers of glass-fiber felt.

B. **F-2**: Cane or other cellulosic fiber, ASTM D1751. Saturated with asphalt.

C. **F-3**: Granulated cork, ASTM D1751. In an Asphalt Binder; encased between two (2) layers of asphalt saturated felt or two (2) layers of glass-fiber felt.

D. **F-4**: Sponge rubber fully compressible, ASTM C1752. With resiliency recovery rate of 90 percent minimum.

E. **F-5**: Cork, ASTM C1752. Impregnated and bound with asphalt, compressible with resiliency recovery rate of 90 percent if not compressed more than 50 percent of original thickness.

F. **F-6**: Plastic foam (for cold-applied sealants only). Preformed, compressible, resilient, non-waxing, non-extruding strips of flexible, non-gassing plastic foam; non-absorbent to water and gas; 30 pounds per cubic foot density maximum, And of size and shape to control sealant depth and performance.

2.4 JOINT FILLER - BACKER ROD, TAPE, POURED FILL TYPE

A. Backer material, ASTM D5249 for cold-applied and hot-applied joint sealant in Portland cement concrete or bituminous concrete pavements joints:

1. Type 1: Round rods.
2. Type 2: Sheets or strips, laminated or skived.
3. Type 3: Poured fills that completely fills pavement joint.

2.5 **JOINT SEALANT - GENERAL**

A. Color of exposed joint sealant indicated, or if not, as selected from manufacturer's standard colors.

2.6 **JOINT SEALANT – HOT APPLIED**

A. **HAS-1**: Asphalt base type, ASTM D3405.

B. **HAS-2**: Thermoplastic type, ASTM D3581. Jet-fuel resistant without rubber unless indicated otherwise.

C. **HAS-3**: Elastic type, ASTM D1190.

D. **HAS-4**: Elastomeric type, ASTM D3406. One component, for Portland cement concrete pavements.

E. **HAS-5**: Elastomeric type, ASTM D3569. One component, jet-fuel resistant, for Portland cement concrete pavements.

2.7 **JOINT SEALANT – COLD APPLIED**

A. **CAS-1**: Elastomeric type, ASTM C920. Chemically curing, for vehicular or pedestrian use, and types of construction other than highway and airfield pavements and bridges and joint substrates indicated; Type S or M; Grade P or NS; Class 25; Use T, NT, M and O:

1. Self leveling.
2. Shore A Hardness, ASTM D2240: 40 plus or minus 5.
3. Final cure: Four (4) days maximum.
4. Service range: -10 to 150 deg F

B. **CAS-2**: Mastic type, ASTM D1851. Single or multiple component; for joints having a minimum width of 1/2 inch.

C. **CAS-3**: Coal-tar modified urethane, FS SS-S-200. One part, jet fuel resistant; Type H.

D. **CAS-4**: Elastomeric preformed polychloroprene type with lubricant adhesive and indicated movement ratio:

1. For concrete pavement seal, ASTM D2628.
2. For concrete bridge seals, ASTM D3542.

E **CAS-5**: Silicone type, ASTM D5893. Single component, non-sag or self leveling, chemically curing sealant based on polymers of polysiloxane structure intended for use in Portland cement concrete pavements.

F. **CAS-6**: Asphalt base meeting ASTM D3405.

G. **CAS-7**: Olefin polymer, ASTM D3575 as follows:

1. Tensile elongation 255 percent plus or minus 20 percent, Suffix T.
2. Tensile strength 115 psi minimum, Suffix T
3. Density 2.9 plus or minus three (3) lbs/cubic foot, Suffix W, Method A
4. Water absorption 0.025 lbs/square foot maximum, Suffix L.

2.8 SOURCE QUALITY CONTROL

A. Preformed Expansion Joint Fillers: Non-extruding and resilient types, ASTM D545.

B. Hot-Applied Joint Sealants:

1. Elastic type used in concrete pavements, bridges, other structures, ASTM D1191.
2. Bituminous type for Portland cement concrete and bituminous concrete pavements, ASTM D3407.
3. Elastomeric type for hydraulic concrete pavement, ASTM D3408.

C. Jet-Fuel-Resistant Joint Sealant: Hot applied, ASTM D3582 and ASTM D3583.

D. Cold-Applied Mastic Joint Sealant: Cold applied, ASTM D1851.

PART 3 EXECUTION

3.1 PREPARATION

A. Remove oil, grease, wax, form-release-agents, curing compounds, bitumens, laitance and old chalking material by sandblast, or water blast as recommended by manufacturer of sealant. Maximum sand blast angle, 25 degrees plus or minus five (5) degrees.

B. Clean and dry with air blast. Do not contaminate air blast with oils or lubricants.

C. Remove frost and moisture in concrete joint substrates before commencing sealing.

D. Install bond breaker tape where needed or required by manufacturer's recommendations to ensure that elastomeric sealants will perform properly.

3.2 JOINT SEALING

A. General:

1. Install sealants in uniform, continuous ribbons without gaps or air pockets, with complete bonding of joint surfaces on opposite sides.
2. Except as otherwise indicated, fill sealant rabbet flush with surface.
3. Where horizontal joints are between a horizontal surface and vertical surface, fill joint to form a slight cove so that joint will not trap moisture and dirt.

B. Depths: Saw cut joints if necessary to provide the required sealant thickness and depth. Install sealant to depths indicated or, if not indicated, as recommended by sealant manufacturer, but within the following general limitations measured at center (thin) section of bead:

1. For sidewalks, pavements, and similar joints sealed with elastomeric sealants and subject to traffic and other abrasion and indentation exposures, fill joints to a depth equal to 75 percent of joint width,

but not more than 5/8 inch deep nor less than 3/8 inch deep.

2. For normal moving joints sealed with elastomeric sealants but not subject to traffic, fill joints to a depth equal to 50 percent of joint width, but not more than 1/2 inch deep nor less than 1/4 inch deep.
3. For joints sealed with non-elastomeric sealants and caulking compounds, fill joints full depth.

C. Spillage: Do not allow poured sealant compound to overflow or spill onto adjoining surfaces or to migrate into voids of adjoining surfaces. Clean adjoining surfaces to eliminate evidence of spillage.

D. Heating: Do not use overheated hot-applied sealants.

E. Edges: Unless indicated otherwise, recess exposed edges of gasket and exposed joint fillers slightly behind adjoining surfaces so compressed units will not protrude from joints.

3.3 CURING AND CLEANING

A. Cure sealants and caulking compounds per manufacturer's instructions and recommendations to obtain high early bond strength, internal cohesive strength and surface durability.

B. Clean off excess sealants or sealant smears adjacent to joints as work progresses. Use methods and cleaning materials approved by manufacturers of joint sealant and of products in which joints occur.

C. Remove protective coating and oil from metals with solvent recommended by the sealant manufacturer.

3.4 PROTECTION

A. Protect joint sealant during and after curing period from contact with contaminating substances or from damage resulting from deterioration or damage at time of substantial completion.

B. If damage or deterioration occurs, cut out and remove damaged or deteriorated joint sealant immediately and reseal joints with new materials to produce joint sealer installations with repaired areas indistinguishable from original work at no additional cost to OWNER.

END OF SECTION

SECTION 32 16 13
DRIVEWAY, SIDEWALK, CURB, GUTTER

PART 1 GENERAL

1.1. **SECTION INCLUDES**

A. Concrete flat work such as waterways, waterway transition structures, sidewalks, curb, gutters, Driveway Approaches, etc.

1.2 **REFERENCES**

A. **APWA (Utah) Standards**:

Plan 205 Curb and gutter.
Plan 206 Curb and gutter dowel tie-in.
Plan 209 Curbs.
Plan 211 Waterway.
Plan 213 Waterway transition structure.
Plan 215 Dip driveway approach.
Plan 216 Mountable curb driveway approach.
Plan 221 Flare driveway approach.
Plan 225 Open driveway approach.
Plan 229 Pipe driveway approach.
Plan 231 Concrete sidewalk.

B. **ASTM Standards**:

A36 Structural Steel.
C39 Compressive Strength of Cylindrical Concrete Specimens.
C172 Sampling Freshly Mixed Concrete.

1.3 **DEFINITIONS**

A. **Driveway**: A paved or unpaved vehicular thoroughfare outside of, but connected to a public road right-of-way or highway right-of-way.

B. **Driveway Approach**: A paved or unpaved vehicular thoroughfare connecting a public road or highway to a Driveway.

1.4 **SUBMITTALS**

A. Traffic control plan, Section 01 55 26.

B. Concrete mix design, Section 03 30 04.

C. Batch ticket, Section 03 30 10.

1.5 QUALITY ASSURANCE

A. If requested, submit a quality control and testing report describing source and field quality assurance activities performed by CONTRACTOR and Suppliers.

1.6 NOTICE

A. Follow Laws and Regulations concerning when and to whom notices are to be given at least two (2) days before work starts.

B. Indicate when concrete work will take place and when driveway approach can be used.

C. Warn of potential vehicle tow away and other construction issues affecting neighborhood.

D. Should work not occur on specified day, send a new notice.

1.7 ACCEPTANCE

A. **General**:

1. Acceptance is by lot. One lot is one day production.
2. If non-complying material has been installed and no price for the material is specified, apply pay adjustment against cost of work requiring material as part of its installation, Section 01 29 00.
3. Dispute resolution, Section 01 35 10 and Section 03 30 05.

B. **Concrete Mix**:

1. Testing Frequency: Section 03 30 05. Sample per ASTM C172.
2. Temperature, Slump, Air: Lot size is 1 random batch. Reject non-complying batches until two (2) consecutive batches are compliant then proceed in random batch testing for acceptance.
3. Strength: Lot size is 50 cubic yards. At ENGINEER's discretion and ASTM C39, a lot with deficient sub-lot strength may be accepted if pay is adjusted using one of the following applicable pay factors, or accepted at 50 percent pay if a sub-lot is in Reject.

Pay Factor	**PSI Below 28 days Compressive Strength**
0.98	1 to 100
0.94	101 to 200
0.88	201 to 300
0.80	301 to 400
Reject	Greater than 400

C. **Placement**, Section 03 30 10:

1. Verify line, grade, cross slope, finish and dimensions.
2. No standing water in curb and gutter.
3. Membrane curing compound applied for total coverage at two (2) times manufacturer's recommended rate in two (2) directions after finishing and texturing.

PART 2 PRODUCTS

2.1 MATERIALS

A. Concrete Mix:
   1. Class 4000 cast-in-place, Section 03 30 04.
   2. Slump range per mix design.

B. Reinforcement: Grade 60 ksi galvanized or epoxy coated steel, Section 03 20 00, deformed.

C. Expansion Joint Filler: F1 sheet 1/2 inch thick, Section 32 13 73.

D. Contraction Joint Filler (Backer Rod): Closed cell, Type 1 round, Section 32 13 73.

E. Contraction Joint Sealer: HAS1 or HAS4 hot applied, Section 32 13 73.

F. Curing Compound: Membrane forming compound, Section 03 39 00.

G. Plate Steel: Galvanized Steel, ASTM A36, Section 05 05 10.

PART 3 EXECUTION

3.1 CONSTRUCTION EQUIPMENT

A. Slip Form Machines:
   1. Placement must produce required cross-section, line, grade, finish, and jointing as specified for formed concrete.
   2. If results are not acceptable, remove and replace work with formed concrete.

3.2 PREPARATION

A. Implement notification and traffic control plan requirements, Section 01 55 26.

B. Examine surfaces scheduled to receive concrete formwork for defects.

C. Do not start work until defects are corrected.

D. Check slopes on each side of the work to ensure drainage. Failure to check and verify will result in CONTRACTOR repairing any drainage deficiencies at no additional cost to OWNER.

3.3 CONCRETE PLACEMENT

A. Section 03 30 10.

B. Make sure base course is uniformly damp at time of concrete placement.

C. Obtain ENGINEER's review of base course and forms before placing concrete.

D. Do not use methods that segregate the mix.

E. Place concrete so time between end of placement and beginning of finishing is less than 15 minutes.

F. Consolidate concrete with vibrator or other acceptable method. Do not use mechanical vibrators. Prevent dislocation of inserts.

3.4 CONTRACTION JOINTS

A. Section 32 13 73.

B. Geometrics:

1. Tooled Joints (Score Lines):

   a. Depth = T/4. T is the depth of the concrete slab in inches.

   b. Top radius = 1/2 inch.

2. Saw Cut Joints: Saw joints before uncontrolled shrinkage cracking occurs. Do not tear or ravel concrete during sawing.

3. Template Joints: 1/8 to 3/16 inch wide 1/4-depth of slab.

C. Sidewalks.

1. At intervals equal to the width of the sidewalk and transverse to the line of walk.

2. Radial at curbs and walk returns.

3. Place longitudinal joints in walks when width of walk in feet is greater than two (2) times the walk thickness in inches. (e.g. maximum width of a four (4) inch thick walk before placement of a longitudinal contraction joint is eight (8) feet). Make longitudinal joints parallel to, or concentric with, the lines of the walk.

4. In walk returns make at least one (1) radial joint midway between beginning of curb returns (BCR) and end of curb returns (ECR). Match longitudinal and traverse joints with joints in adjacent walks.

D. Curb, Gutter, Waterway:

1. Place joints at intervals not exceeding 12 feet.

2. At curb radius and walk returns make joints radial.

3. Where integral curb and gutter is adjacent to concrete pavement, align joints with pavement joints where practical.

3.5 EXPANSION JOINTS

A. General: Section 32 13 73:

1. 1/2 inch wide full depth filler that is flush with concrete surface. Do not place seal over top of joint filler.

B. Sidewalks:

1. Place expansion joints to separate sidewalk from utility poles, hydrants, manhole frames, buildings and abutting sidewalks.

2. Place expansion joints between sidewalk and back of curb returns and between sidewalk and sidewalk ramps.

3. Do not place expansion joints in sidewalk ramp surfaces.

4. Expansion joints are not required when using slip form method to place concrete except where sidewalk changes direction or where it joins foundation walls or structures.

C. Curb, Gutter, Waterway:

1. Do not place longitudinal joint in drain gutter flow-line.
2. Where drain gutter transitions extend beyond curb return, place expansion joints at ends of drain gutter transition.
3. Place expansion joints at beginning of curb radius (BCR) and at end of curb radius (ECR).

D. Curb and Gutter Dowel Te-in: Follow APWA Plan 206 requirements. Tie-in occurs between new and existing curb and gutter.

E. Slip Form Work: Expansion joints are not required except at BCR or ECR.

F. Driveway Approach: Do not place expansion joints in curb returns.

G. Street Intersection Corner: Place expansion joints at BCR and ECR.

3.6 **FINISH**

A. Section 03 35 00.

B. Round edges exposed to public view to a 1/2 inch radius.

C. Apply broom finish longitudinal to curb and gutter flow-line.

D. Apply broom finish transverse to sidewalk centerline as follows:

1. Fine hair finish where grades are less than six (6) percent.
2. Rough hair finish where grades exceed six (6) percent.

E. Remove form marks or irregularities from finish surfaces.

3.7 **TOLERANCES**

A. Curb, Gutter, Curb and Gutter: APWA Plan 205, 209, 211, 213.

1. Line: Less than 1/2 inch variance in 10 feet and not more than 1 inch from true line at any location.
2. Grade: Not more than 1/4 inch variance in 10 feet. Flood curb and gutter with water after final set has been reached. Remove and replace any area where ponding is found.
3. Standing Water: None allowed.

B. Sidewalk: APWA Plan 231:

1. Cross slope one (1) percent minimum, two (2) percent maximum.
2. Standing Water: None allowed.

C. Driveway Approach: APWA Plan 215, 216, 221, 225, 229.

3.8 CURING

A. Section 03 39 00.

B. Curing compound: Apply at two (2) times manufacturer's recommended rate. Apply total coverage in two (2) directions after texturing.

C. Eliminate thermal shock of concrete by keeping cure temperature even throughout extent and depth of concrete slab.

3.9 PROTECTION AND REPAIRS

A. General: All expenses are at no additional cost to OWNER.

B. Protection: Section 03 30 10:

1. Protect concrete work from deicing chemicals during the 28 days cure period.
2. Immediately after placement, protect concrete from graffiti or other types of mechanical injury.

C. Repair: Section 03 30 10. Consider also guidelines published by the American Concrete Pavement Association (ACPA). Do not begin corrective work until ENGINEER agrees with repair option:

1. Correct all humps or depressions.
2. Standing Water: Remove and replace any area where ponding is found. If necessary, flood construction to determine ponding extent.
3. Restore surfaces damaged by saw cutting, grinding, or removal operations.

END OF SECTION

SECTION 32 16 14
CURB CUT ASSEMBLY

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Concrete flat work for public right-of-way accessibility.

1.2 REFERENCES

A. **APWA (Utah) Standards**:

Plan 235 Corner curb cut assembly.

Plan 236 Tangent curb cut assembly.

Plan 237 Islands and median.

Plan 238 Detectable warning surface.

1.3 DEFINITIONS

A. **Approach**: An Element in a pedestrian access route that connects a sidewalk to a Blended Transition or a Turning Space. It has a Running Slope of 8.33 percent (1:12) maximum, a Cross Slope of five (5) percent (1:20) maximum, and a Running Length to be determined by the ENGINEER.

B. **Blended Transition**: An Element in a pedestrian access route that connects a sidewalk or an Approach to a Crosswalk. It is 4 feet wide minimum and has a Running Slope of 5 percent (1:20) or less. Cross Slope may vary as follows:

1. Five (5) percent maximum at corners with no yield or stop controls.
2. Two (2) percent maximum at corners with yield or stop controls.
3. Street or highway grade at midblock.

C. **Clear Space**: An Element in a pedestrian access route that is located beyond the foot of a Curb Ramp, Turning Space, or Blended Transition and is within the width of the Crosswalk. Its dimensions are 4 feet minimum by 4 feet minimum with a Running Slope of 5 percent (1:20) maximum. Cross Slope may vary as follows:

1. Five (5) percent maximum at corners with no yield or stop controls.
2. Two (2) percent maximum at corners with yield or stop controls.
3. Street or highway grade at midblock.

D. **Counter Slope**: Running Slope of the roadway surface in a Crosswalk (including the pan of the gutter).

E. **Cross Slope**: Grade perpendicular to the direction of pedestrian travel usually expressed in percent.

F. **Cross Width**: Distance perpendicular to the direction of pedestrian travel usually expressed in linear measure.

G. **Crosswalk (or Pedestrian Street Crossing)**:

1. Unmarked: That part of a roadway at an intersection included within the connections of the lateral lines of the sidewalks on opposite sides of the roadway measured from the curbs or in the absence of curbs, from the edges of the traversable roadway. In the absence of a sidewalk on one side of the roadway, that part of a roadway included within the extension of the lateral lines of the sidewalk at right angles to the center line;
2. Marked: Any portion of a roadway at an intersection or elsewhere distinctly indicated as a pedestrian crossing by pavement marking lines on the surface, which might be supplemented by contrasting pavement texture, style, or color.

H. **Curb Ramp**: An Element in a pedestrian access route that is 4 feet wide minimum, has a Running Slope from 5 percent (1:20) to 8.33 percent (1:12) maximum and is not required to be more than 15 feet long. Curb ramps are perpendicular to or parallel with a curb. A perpendicular curb ramp abuts or cuts through the curb and its Turning Space is at the top of the ramp. A parallel curb ramp abuts the curb and its Turning Space abuts or cuts through the curb. Cross Slope may vary as follows:

1. Five (5) percent maximum at corners with no yield or stop controls.
2. Two (2) percent maximum at corners with yield or stop controls.
3. Street or highway grade at midblock.

I. **Detectable Warning Surface**: A surface feature of truncated dome material built into the walking surface to advise a pedestrian of an upcoming change from pedestrian to vehicular way.

J. **Element**: An architectural or mechanical component of a building, facility, space, site, or public right-of-way.

K. **Grade Break**: The line where two surface planes with different grades meet flush.

L. **Running Length**: Distance parallel to the direction of pedestrian travel usually expressed in linear measure.

M. **Running Slope**: Grade parallel to the direction of pedestrian travel usually expressed in percent.

N **Turning Space (or Landing)**: An element in a pedestrian access route that connects an Approach or a sidewalk to a Curb Ramp, a Blended Transition or a Clear Space. It is 4 feet minimum by 4 feet minimum. If constrained on 2 sides, it must be 5 feet minimum in the direction of the Curb Ramp or Blended Transition. It's Running Slope and Cross Slope is 2 percent (1:50) maximum. At midblock Crosswalks without stop control, the Cross Slope is permitted to equal the street or highway grade.

1.4 **SUBMITTALS**

A. Field quality control ‘pass-fail’ checklist data.

B. Traffic control plan, Section 01 55 26.

C. Concrete mix design, Section 03 30 04.

D. Batch ticket, Section 03 30 10.

E. Detectable warning surface product data sheet.

1.5 **OWNER’S INSTRUCTIONS**

A. **Alteration**s: If the direction of water flow in an existing curb and gutter system is not apparent, proceed as follows:

1. Flood curb and gutter system to determine extent of replacement.
2. Flood curb and gutter system after installation to verify drainage.

B. **Steep Slopes**: Prior to placing concrete, allow ENGINEER time to check slopes and dimensions of construction forms.

1.6 **ACCEPTANCE**

A. Clear Space: Located within Crosswalk, Running Slope, Cross Slope.

B. Flow-line: No standing water, no trip hazard.

C. Detectable Warning Surface:

1. Color contrast, dome geometry, joints between units.
2. Cross Width, Running Length.

D. Curb Cut: Cross Width (appropriate to number of crosswalks served).

E. Turning Space: Running Slope, Cross Slope, dimensions.

F. Curb Ramp: Running Slope, Cross Slope, Cross Width.

G. Blended Transition: Running slope, Cross Slope, Cross Width.

PART 2 PRODUCTS

2.1 **CONCRETE**

A. Class 4000, Section 03 30 04.

2.2 **DETECTABLE WARNING SURFACE**

A. Concrete paver, ribbed composite panel, or tile.

B. Properties:

1. Homogenous color.
2. High shear strength domes.
3. Slip resistant, freeze thaw resistant, UV resistant.

PART 3 EXECUTION

3.1 PREPARATION

A. Implement notification and traffic control plan requirements, Section 01 55 26. Provide safe passage for pedestrians and vehicles.

B. Assist visually impaired and wheel chair users.

C. Provide continuous access to fire hydrants.

D. Keep passage ways free of construction materials, trash and debris.

E. Remove graffiti immediately.

3.2 INSTALLATION

A. Layout, APWA Plans 235, 236, 237, and 238.

B. Place concrete, Section 03 30 10.

C. Install Detectable Warning Surface full width of curb cut.

3.3 FIELD QUALITY CONTROL

A. Use the ‘pass-fail’ checklist in Table 1 to verify that the curb cut assembly complies with layout requirements.

3.4 CLEANING AND REPAIR

A. Remove all debris and concrete dust.

B. Clean surrounding handrails, sidewalks, driveways approaches, landscaping, and other objects in vicinity of work.

C. Repair surfaces damaged by saw cutting, grinding, or removal operations at no additional cost to OWNER.

END OF SECTION

SECTION 32 17 23
PAVEMENT MARKINGS

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Words, striping, and other pavement markings.

B. One-way or two-way prismatic reflectors.

1.2 REFERENCES

A. **AASHTO Standards**:

M237 Epoxy Resin Adhesive for Bonding Traffic Markers to Hardened Concrete.

M247 Glass Beads Used in Traffic Paint.

M248 Ready-Mixed White and Yellow Traffic Paints.

M249 White and Yellow Reflective Thermoplastic Striping Material (Solid Form).

B. **ASTM Standards**:

D638 Tensile Properties of Plastics.

E303 Measuring Surface Frictional Properties Using the British Pendulum Tester.

E1710 Measurement of Retroreflective Pavement Marking Materials with CEN-Prescribed Geometry Using a Portable Retroreflectometer.

C. **DOT Standards**:

MUTCD Manual on Uniform Traffic Control Devices for Streets and Highways.

1.3 DEFINITIONS

A. **Retroreflective**: Majority of reflected light is directed back to the light source.

1.4 SUBMITTALS

A. Product data for primer to be used for tape applications.

B. Manufacturer's affidavit certifying paint products meet or exceed material requirements of this section.

C. Sample of prismatic reflector to be used along with manufacturer's statement of the reflector's minimum reflective area and specific intensity at the 0.2 degrees observation angle.

D. Manufacturer's recommendation for type of adhesive to be used.

E. Samples of each thermoplastic or preformed plastic pavement markings along with manufacturer's instructions of how the materials are to be applied.

1.5 QUALITY ASSURANCE

A. At the end of the correction period, pavement markings, when applied according to the recommendations of the manufacturer, show a neat, durable marking with no flow or distortion due to temperature if the pavement surface remained stable. The tape shows no appreciable fading, lifting or shrinkage, and no significant tearing, roll back or other sign of poor adhesion.

1.6 WEATHER

A. Apply pavement striping and markings only when pavement surface is dry and air temperature is above 40 deg F during daylight hours.

B. Do not apply pavement striping and markings when rain is anticipated within 12 hours.

PART 2 PRODUCTS

2.1 GLASS BEADS

A. AASHTO M247.

2.2 FILM AND ADHESIVE

A. **Film**: A pliant polymer with retroreflective glass beads distributed throughout its cross-sectional area and bonded to its top surface. The film is selected and blended to conform to standard white or yellow highway colors and has a minimum thickness of 0.06 inches at pattern height.

1. Skid Resistance: 35 BPN minimum, ASTM E303.
2. Tensile Strength: ASTM D638. Using a Sample size 6 x 1 inch, a temperature between 70 and 80 deg F, and a test jaw speed of 10 to 12 inches per minute, the film has an elongation of 75 percent maximum at break and a strength as follows.
   a. Type 1: 150 pounds minimum tensile strength per square inch of cross-section area.
   b. Type 2: 40 pounds minimum tensile strength per square inch of cross-section area.
3. Reflectivity: Meet film reflectivity in the following table.

Table 1 - Film Reflectivity

Application	Tensile Strength	Color	
		White	Yellow
Non-residential	Type 1	500	350
Residential	Type 2	300	250

NOTES
(a) Follow ASTM E1710 procedures using 30 meter test distance, an entrance angle of 88.76 degrees, and an observation angle of 1.05

degrees.
(b) Reflectivity is measured in millicandelas per square foot per footcandle (mcd/sf/fc).

B. **Adhesive**:

1. Class 1: Without pre-coated adhesive for applications with surface preparation adhesive recommended by the manufacturer at temperatures of 40 deg F or above and moderate humidity.
2. Class 2: With pre-coated pressure sensitive adhesive with minimum adhesion value of 1.1 pounds per inch width, AASHTO M237

2.3 **PAINT**

A. Alkyd type F (fast dry) ready-mix, AASHTO M248.

B. Thermoplastic, AASHTO M249.

2.4 **PRISMATIC REFLECTORS**

A. Unless indicated otherwise, provide single lens snowplow resistant reflectors of the color indicated:

1. With a cast iron housing and acrylic prismatic reflector.
2. With an overall size not less than nine (9) inches long, five (5) inches wide, and 1-3/4 inch thick with a 7/16 inch maximum projection above its base.
3. With a minimum reflective area of 1.6 square inches per face.

B. Reflector Specific Intensity: Meet intensity in the following table.

Table 2 - Intensity

Color	Entrance Angle	
	0 Degrees	**20 Degrees**
White	3.0	1.2
Yellow	1.8	0.72

NOTES
(a) Intensity measured at 0.2 degree observation angle.

PART 3 EXECUTION

3.1 **CONSTRUCTION EQUIPMENT**

A. Use equipment manufactured for pavement marking. Use workers experienced in operating such equipment.

B. Use equipment capable of applying a strip, or strips with a width tolerance of plus or minus 1/4 inch. Equip machine with an automatic skip control giving a 10 feet long marked segment and a 30 feet long gap within a linear tolerance of six (6) inches over that cycle.

C. If applying glass beads, locate bead applicator directly behind and synchronized with marking applicator.

D. For thermoplastic paint materials, use equipment that is designed to

agitate the paint to prevent scorching, discoloration, or excessive high temperatures.

3.2 PREPARATION

A. **General**: DO NOT begin pavement painting and marking operations without ENGINEER's knowledge of such activity.

B. **Repair of Receiving Surface**: Method of payment to be determined by ENGINEER if any of the following repairs are required.

1. Raising low areas to grade, lowering high areas to grade, hole patching, inlays.
2. Crack sealing and crack repairing, Section 32 01 17.
3. Pushing or shoving pavement repair.
   a. Mill damaged area at least three (3) inches below required surface elevation.
   b. Install and compact three (3) inches of bituminous concrete, Section 32 12 16.13. ENGINEER to determine Mix Designator.

C. **Traffic Control**:

1. Implement notification and traffic control plan requirements, Section 01 55 26. Provide safe passage for pedestrians and vehicles. Do not proceed without certified flaggers if work requires.
2. Grind off confusing pavement markings and lane stripes.

D. **Cleaning**: Broom or flush the surface to remove dirt, loose stones, or other foreign material. For better adhesion results clean the surface using high velocity compressed air.

E. **Mark Roadway**: Mark roadway between control points established by ENGINEER. ENGINEER will establish points on tangent at least every 100 feet and at 25 feet long intervals on curves. Maintain the line within 1 inch of the established control points. ENGINEER may also designate other pavement striping locations such as stop bars, crosswalks, zebra striping, etc.

F. **Markings**: Markings that adhere to bituminous concrete or Portland cement concrete by either a pressure sensitive pre-coated adhesive or an epoxy cement shall mold to the pavement contours by traffic action at normal pavement temperatures and shall be ready for traffic immediately after application.

3.3 INSTALLATION - ALKYD RESIN PAINT STRIPING

A. Adjust pavement striping machine to apply paint at rate recommended by paint manufacturer. Provide two (2) applications over new pavement (pavement correction period has not expired)

B. Glass Bead Application Rate (Final Application): 5.9 to 6.1 pounds per gallon of paint.

C. Protect the markings until dry by placing approved guarding or warning device wherever necessary. Remove any markings not authorized or smeared or otherwise damaged, or correct as approved by ENGINEER.

3.4 INSTALLATION - THERMOPLASTIC PAINT STRIPING

A. Clean off dirt, glaze, and grease before pre-striping.

B. Pre-stripe the application area with a binder material that will form, when sprayed, a continuous film over pavement surface, and will dry rapidly and mechanically adhere to pavement surface. Install material in varying widths if indicated.

C. At a temperature recommended by the equipment manufacturer, extrude thermoplastic material from equipment that is proven to produce a line 1/8 inch to 3/16 inch thick, continuous, uniform in shape and has clean and sharp dimensions.

D. Do not use material that produces fumes that are toxic, obnoxious, or injurious to persons or property.

E. Apply so finished lines have well-defined edges free of waviness.

F. Glass Bead Application Rate: Six (6) pounds of glass beads to every 100 square feet of marking.

3.5 INSTALLATION - TAPE STRIPING

A. Apply pavement marking tape as indicated or directed. ENGINEER will establish control points.

B. Apply tape only on surfaces that are dry and free of oils, grease, dust and dirt, and primed at the rate of approximately 1 quart per 60 feet with an approved primer material.

C. Maintain the line on established control points. Apply intermittent pavement marking tape 24 inches long, spaced approximately 100 feet on tangents, and approximately 25 feet on curves unless otherwise directed. The ENGINEER will designate other pavement striping locations such as stop bars, crosswalks, zebra striping, etc.

D. Press down tape immediately after application until it adheres and conforms to pavement surface.

E. Completely remove all tape on sections where tape conflicts with revised traffic lanes before opening new lanes to traffic.

3.6 INSTALLATION PAVEMENT MARKING FILMS

A. Apply before traffic is allowed on freshly paved surface.

B. Unless indicated otherwise, provide Type 1, Class 2, polymer film markings in specified widths and shapes. Provide and layout words and marking symbol configurations per MUTCD requirements and as indicated.

C. When indicated, inlay markings in fresh bituminous concrete pavement with a compaction roller during the paving operation.

D. Apply all markings in accordance with manufacturer's recommendations.

3.7 INSTALLATION - PRISMATIC REFLECTORS

A. Install reflectors by cutting pavement and partially filling cut area with epoxy adhesive. Place reflector housing in the adhesive and apply pressure to properly seat. Allow epoxy to completely set before allowing traffic on markers.

B. Install markers so that housing top surface and edges are flush with pavement surface.

3.8 INSTALLATION - WORDS, SYMBOLS AND OTHER MARKINGS

A. Wet sandblast existing or temporary pavement markings that may be confusing. Removal of markings by high-pressure water may be used if approved by ENGINEER.

B. Apply word markings, letters, numerals and symbols with indicated stencils and templates. In the absence of such information all stencils and templates shall be identical to those currently used by OWNER.

3.9 REPAIR

A. Before the end of the correction period, renew stripes and markings if original visual effectiveness is reduced by 50 percent.

END OF SECTION

SECTION 32 91 19
LANDSCAPE GRADING

PART 1 GENERAL

1.1 **SECTION INCLUDES**

A. Landscape grading requirements.

B. Backfill materials.

1.2 **SUBMITTALS**

A. Submit maximum laboratory dry density and optimum laboratory moisture content for:

1. Subgrade material, and
2. Each type of fill to be used.

1.3 **QUALITY ASSURANCE**

A. Do not change material sources, or aggregate without ENGINEER's knowledge.

B. Reject backfill material that does not comply with requirements in this Section.

C. Landscape grading is aesthetic by nature and subject to continual monitoring and modification during the backfilling process. Work closely with ENGINEER particularly when grading and construction berms, channels, or other aesthetic considerations.

D. If requested, submit a quality control and testing report describing source and field quality assurance activities performed by CONTRACTOR and Suppliers.

1.4 **STORAGE**

A. Safely stockpile backfill materials.

B. Separate differing materials, prevent mixing, and maintain optimum moisture content of backfill materials.

C. Avoid displacement of and injury to Work while compacting or operating equipment.

D. Movement of construction machinery over Work at any stage of construction is solely at CONTRACTOR's risk.

1.5 **SITE CONDITIONS**

A. Do not place, spread, or roll any backfill material over material that is damaged by water. Remove and replace damaged material at no additional cost to OWNER.

B. Control traffic and erosion. Keep area free of trash and debris. Repair settled, eroded, and rutted areas.

C. Reshape and compact damaged structural section to required density.

1.6 **ACCEPTANCE**

A. Native material may be wasted if there is no additional cost to substitute material acceptable to ENGINEER.

B. For material acceptance refer to:

1. Common fill, Section 31 05 13.
2. Crushed aggregate base, Section 32 11 23.
3. Cement treated fill, Section 31 05 15.

1.7 **WARRANTY**

A. Any settlement noted in landscaped surfaces will be considered to be caused by improper compaction methods and shall be corrected at no additional cost to the OWNER.

B. Restore incidentals damaged by settlement at no additional cost to OWNER.

PART 2 PRODUCTS

2.1 **BACKFILL MATERIALS**

A. Common fill, Section 31 05 13.

B. Cement treated fill, Section 31 05 15.

C. Crushed aggregate base, Section 32 11 23.

D. Structural soil mix, Section 32 91 13.

2.2 **WATER**

A. Make arrangements for sources of water during construction and make arrangements for delivery of water to site.

B Comply with local Laws and Regulations at no additional cost to OWNER when securing water from water utility company.

PART 3 EXECUTION

3.1 **PREPARATION**

A. Implement traffic control plan requirements, Section 01 55 26.

B. Identify required line, levels, contours, and datum.

C. Stake and flag locations of underground utilities.

D. Upon discovery of unknown utility or concealed conditions, notify ENGINEER.

E. Verify stockpiled fill meets gradation requirements, areas to be backfilled are free of debris, snow, ice or water, and ground surface is not frozen.

F. If subgrade is not readily compactable secure written authorization for

stabilization excavation and backfill. Refer to Section 31 23 16.

3.2 PROTECTION

A. Protect existing trees, shrubs, lawns, existing structures, fences, roads, sidewalks, paving, curb and gutter and other features.

B. Protect above or below grade utilities. Contact utility companies to repair utility damage. Pay all cost of repairs.

C. Protect subgrade from desiccation, flooding and freezing.

D. Do not fill adjacent to structures until Excavation is checked by ENGINEER.

E. Do not use compaction equipment adjacent to walls or retaining walls that may cause wall to become over-stressed or moved from alignment.

F. Do not disturb or damage foundation perimeter drainage, foundation, damp-proofing, foundation waterproofing and protective cover, or utilities in trenches.

G. Restore any damaged structure to its original strength and condition.

3.3 LAYOUT

A. Maintain all benchmarks, control monuments and stakes, whether newly established by surveyor or previously existing. Protect from damage and dislocation.

B. If discrepancy is found between Contract Documents and site, ENGINEER shall make such minor adjustments in the Work as necessary to accomplish the intent of Contract Documents without increasing the Cost of the Work to CONTRACTOR or OWNER.

3.4 BACKFILLING

A. General: Conduct work in an orderly manner. Do not create a nuisance. Do not permit soil accumulation on streets or sidewalks. Do not allow soil to be washed into sewers and storm drains.

B. Grading Intent: Spot elevations and contours indicated are based on the best available data. The intent is to maintain constant slopes between spot elevations. If a spot elevation is determined to be in error, or the difference in elevation between points change, then the minimum percentage of slope as a result of field adjustment of specific spot elevations is as follows:

1. Pavement Areas: 1 percent.
2. Concrete or Brick Areas: 0.30 percent.
3. Lawn or Planted Area: 0.75 percent.

C. Planted Surfaces:

1. Place backfill to a finished grade.
2. Grade slopes to provide adequate drainage after compaction. Do not create water pockets or ridges. Prevent erosion of freshly graded areas during construction until surfaces have been constructed and landscaping areas have taken hold.
3. Remove surface stones greater than 1 inch from finished grading.

D. Hard Surfaces: Place structural soil to depth specified.

3.5 MODIFIED BACKFILL LAYER METHOD

A. Section 33 05 20.

3.6 COMPACTION

A. Ninety-two (92) percent relative to a standard proctor density, Section 31 23 26, unless indicated elsewhere.

3.7 SURFACE FINISHING

A. Restore paved surfaces, Section 33 05 25.

B. Finish landscaped surfaces to match existing with grass, Section 32 92 00 or with other ground cover, Section 32 93 13.

1. Backfill areas to contours and elevations required. Do not use frozen materials.
2. Make smooth changes in grade. Blend slopes into level areas.
3. Remove surplus backfill materials from site.
4. Leave stockpile areas completely free of excess fill materials.
5. Slope grade away from building at a minimum of five (5) percent for ten (10) feet unless indicated otherwise.

3.8 CLEANING

A. Remove stockpiles from the site. Grade site surface to prevent free standing surface water.

B. Leave borrow areas clean and neat.

END OF SECTION

DIVISION 33

UTILITIES

SECTION 33 05 02
CONCRETE PIPE AND CULVERT

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Reinforced and non-reinforced concrete pipe and culvert, fittings and joint materials.

1.2 REFERENCES

A. **AASHTO Standards**:

HB-17 Highway Bridges.

LRFD Bridge Design Specifications, Customary U.S. Units.

M198 Joints for Concrete Pipe, Manholes, and Precast Box Sections using Preformed Flexible Joint Sealants.

B. **ASTM Standards**:

C14 Concrete Sewer, Storm Drain, Culvert Pipe.

C76 Reinforced Concrete Culvert, Storm Drain, and Sewer Pipe.

C118 Concrete Pipe for Irrigation or Drainage.

C150 Portland Cement.

C361 Reinforced Concrete Low-Head Pressure Pipe.

C412 Concrete Drain Tile.

C443 Joints for Circular Concrete Sewer and Culvert Pipe, Using Rubber Gaskets.

C444 Perforated Concrete Pipe.

C497 Testing Concrete Pipe, Sections, or Tile.

C505 Non-Reinforced Concrete Irrigation Pipe with Rubber Gasket Joints.

C507 Reinforced Concrete Elliptical Culvert, Storm Drain, and Sewer Pipe.

C654 Porous Concrete Pipe.

C655 Reinforced Concrete D-Load Culvert, Storm Drain and Sewer Pipe.

C985 Non-reinforced Concrete Specified Strength Culvert, Storm Drain, and Sewer Pipe.

C1433 Precast Reinforced Concrete Monolithic Box Sections for Culverts, Storm Drains, and Sewers. (Designed according to AASHTO BH-17).

C1479 Installation of Precast Concrete Sewer, Storm Drain, and

Culvert Pipe Using Standard Installations.

C1504 Precast Reinforced Concrete 3 Sided Structures for Culverts and Storm Drains.

C1577 Precast Reinforced Concrete Monolithic Box Sections for Culverts, Storm Drains, and Sewer (Designed according to AASHTO LRFD).

C. **AWWA Standards**:

C302 Reinforced Concrete Pressure Pipe, Non-cylinder Type, for Water and Other Liquids.

1.3 **SUBMITTALS**

A. Precast box culvert design summary.

B. Manufacturer's proof of certification.

1.4 **QUALITY ASSURANCE**

A. Manufacturer and Transporter: Certified per Section 03 34 00.

B. Pipe:

1. Remove and replace pipe that show exposed reinforcing steel, honeycomb or open texture.
2. Repair or replace reinforced concrete pipe if cracks are greater than 0.10 inch.

PART 2 PRODUCTS

2.1 **PIPE AND FITTINGS**

A. Provide type, class, strength and size of pipe and fittings required.

B. Concrete:

1. Use ASTM C150 or C1157 cement unless required otherwise.
2. Admixtures and pozzolans may be used only with approval.

C. Gravity Pipe System:

1. Reinforced Concrete Pipe: ASTM C76 or ASTM C655.
2. Non-reinforced Pipe: ASTM C14 in sizes up to 36" diameter and ASTM C985 for pipe up to 60" diameter.
3. Irrigation or Drainage Pipe: ASTM C118 or ASTM C505.
4. Drainage Tile: ASTM C412.
5. Perforated Pipe: ASTM C14 Type 1 Class 2 or ASTM C444.
6. Elliptical Pipe: ASTM C507.
7. Porous Concrete Pipe: ASTM C654.
8. Perforated Concrete Pipe: ASTM C444.
9. Precast Box Section Bridge: ASTM C1433 or ASTM C1577 as applicable.

10. Three Sided Culvert: ASTM C1504.

D. Low Head Pressure Pipe Systems: ASTM C361 or AWWA C302.

2.2 JOINTS

A. Use ASTM C443 rubber gasket bell and spigot type joints.

B. For box sections use tongue and groove joints with bituminous mastic joint sealant.

C. For elliptical sections use tongue and groove joints with bituminous mastic joint sealant, AASHTO M198.

D. Mortar: Portland cement, Section 04 05 16.

2.3 SOURCE QUALITY CONTROL

A. Pipe and tile, ASTM C497.

B. Box sections, ASTM C1433.

C. Three sided culverts, ASTM C1504.

PART 3 EXECUTION

3.1 FACTORY FITTINGS

A. Fit all service tees and other miscellaneous fittings with an expanding plug.

B. Grout all fittings to provide a smooth interior and exterior surface.

C. When providing pipe or box sections specifically manufactured with branch connections, carefully shape and fit adjoining pieces to facilitate grouting. Grout all fittings to provide a smooth interior and exterior surface. Lateral pipe or sections shall not project beyond the inner surface of pipe.

D. Use epoxy adhesive grout, Section 03 61 00 as interface between new and existing concrete and piping materials.

3.2 INSTALLATION - PIPE AND FITTINGS

A. Assembly: Abide by manufacturer's instructions, ASTM C1479, and the following. Use the more stringent provisions if there are any conflicts.

1. Pressurized Systems:

   a. Water distribution and transmission, Section 33 11 00.

   b. Underground irrigation, Section 32 84 23.

2. Gravity Systems:

   a. Sanitary sewers, Section 33 31 00.

   b. Under drains and storm drains, Section 33 41 00.

B. Burial: Comply with Section 33 05 20 and the following.

1. Place circular concrete pipe that contains elliptical reinforcing so that the reference lines designating the top of the pipes will not be more than five (5) degrees from the vertical plane through the longitudinal axis of the pipe.

3.3 INSTALLATION - BOX SECTIONS

A. Assembly: Abide by manufacturer's instructions, and Section 33 41 00 for under drains and storm drain systems. Use the more stringent provisions if there are any conflicts.

1. Install per manufacturer’s instructions.
2. Provide a leveling course under box section. Use Sewer Rock unless specified otherwise.
3. Pull sections together using internal winches or tugger. Do not push box section together. Pushing causes joint misalignment.
4. Limit joint gap to maximum specified by manufacturer. Remove excess bituminous mastic joint sealant from interior box wall, floor, and ceiling.

B. Burial: Comply with Section 33 05 20.

END OF SECTION

SECTION 33 05 05
DUCTILE IRON PIPE

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Ductile iron pipe, couplings, fittings, and joint materials.

1.2 REFERENCES

A. **AWWA Standards**:

C104 Cement-Mortar Lining for Ductile-Iron Pipe and Fittings for Water.

C110 Ductile-Iron and Gray Iron Fittings, 3 In. Through 48 In., for Water and Other Liquids.

C111 Rubber-Gasket Joints for Ductile-Iron and Gray-Iron Pressure Pipe and Fittings.

C115 Flanged Ductile-Iron and Gray Iron Pipe with Threaded Flanges.

C151 Ductile-Iron Pipe, Centrifugally Cast in Metal Molds or Sand-Lined Molds, for Water or Other Liquids.

C600 Installation of Ductile-Iron Water Mains and Their Appurtenances.

1.3 QUALITY ASSURANCE

A. Repair damaged delaminated, or scaled coating on pipe.

PART 2 PRODUCTS

2.1 PIPE AND FITTINGS

A. Buried Applications:

1. Class 52 or pressure class 350 psi ductile iron pipe, AWWA C151 with push-on joints, AWWA C111.
2. Cement lining for all pipe and fittings, AWWA C104.
3. Class 250 fittings with AWWA C110 joints.
4. Coupler with mechanical joint fittings, AWWA C104, C110, and C111.
5. Rubber gasket slip-on pipe joints, AWWA C111 with gasket lubricant.

6. Bronze wedges with current capacity of 400 amps each for each joint as follows:

Pipe Diameter	No. of Wedges
less than 10”	2
10”	3
12”	4
greater than 12”	6

B. Above Ground Applications: As buried applications, except use bolted flanged fittings, AWWA C104, C110, and C115.

2.2 COVERINGS

A. Buried Mechanical Joints: Grease and eight (8) mil vinyl wrap plastic cover.

PART 3 EXECUTION

3.1 INSTALLATION

A. Assembly: Abide by manufacturer’s instructions, AWWA C600, and the following. Use the more stringent provisions if there are any conflicts.

1. Pressurized Systems:
   a. Water distribution and transmission, Section 33 11 00.
   b. Underground irrigation, Section 32 84 23.
2. Gravity Systems:
   a. Sanitary sewers, Section 33 31 00.
   b. Under drains and storm drains, Section 33 41 00.

B. Burial: Comply with Section 33 05 20.

1. Protect ferrous materials with polyethylene sheet that is at least six (6) mil thick. Tape wrap the sheet around the pipe.

END OF SECTION

SECTION 33 05 06
POLYETHYLENE PIPE

PART 1 GENERAL

1.1. SECTION INCLUDES

A. Polyethylene pipe, couplings, fittings and joint materials.

1.2 REFERENCES

A. **AASHTO Standards**:

M252 Corrugated Polyethylene Drainage Pipe.

M294 Corrugated Polyethylene Drainage Pipe 300-1200 mm Diameter.

MP7-97 Corrugated Polyethylene Pipe – 1350 and 1500 mm Diameter.

NTPEP National Transportation Product Evaluation Program.

B. **ASME Standards**:

B1.1 Unified Inch Screw Threads (UN and UNR Thread Form), Supplement.

C. **ASTM Standards**:

A307 Carbon Steel Bolts and Studs, 60,000 psi Tensile Strength.

D2239 Polyethylene (PE) Plastic Pipe (SDR-PR) Based on Controlled Inside Diameter.

D2321 Underground Installation of Flexible Thermoplastic Sewer Pipe.

D2657 Heat Joining of Thermoplastic Pipe and Fittings.

D2774 Underground Installation of Thermoplastic Pressure Piping.

D3261 Butt Heat Fusion Polyethylene (PE) Plastic Fittings for Polyethylene (PE) Plastic Pipe and Tubing.

D3350 Polyethylene Plastics Pipe and Fittings Materials.

F477 Elastomeric Seals (Gaskets) for Joining Plastic Pipe.

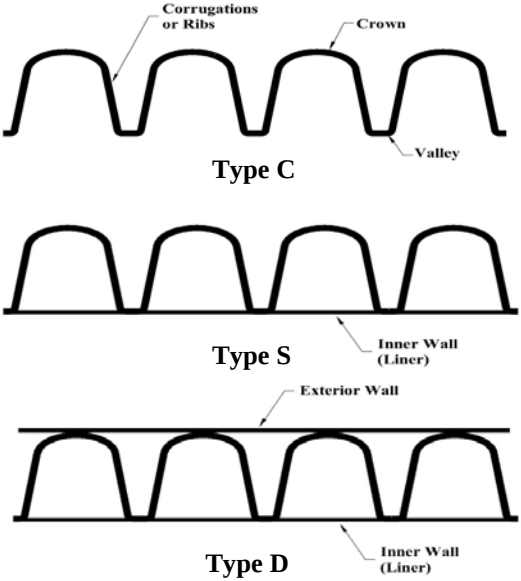
F1055 Electofusion Type Polyethylene Fittings for Outside Diameter Controlled Polyethylene Pipe and Tubing.

1.3 DEFINITIONS

A. **Standard Dimension Ratio (SDR):** Average diameter of pipe divided by the minimum wall thickness. The diameter may be either inside or outside measurement depending upon which standard is referenced.

B. **Code Designation**: A rating system by the Plastic Pipe Institute for smooth wall polyethylene pipe materials. The designation PE 3408 designates the type of plastic pipe (PE), the grade (34), and the hydrostatic design stress measured in units of 100 psi (08) at 23 deg C.

C. **Corrugated Wall Pipe Classifications**: Classifications are shown below. Types S and D have corrugations either annular or helical.



D. **Porous Corrugated Wall Pipe**: Classified as follows.

1. Type CP - This is Type C pipe with perforations.
2. Type SP - This is Type S pipe with perforations.

1.4 **SUBMITTALS**

A. Thermoplastic pipe manufacturer is compliant with AASHTO NTPEP for the diameter of pipe specified in the Contract Documents.

1.5 **QUALITY ASSURANCE**

A. Evaluate pipes that show damage such as dents, cuts, cracks, breaks, fractures, or distortions. Recommend appropriate action. ENGINEER may require CONTRACTOR provide certification by a professional engineer competent in the structural design of the pipe material for action recommended.

PART 2 PRODUCTS

2.1 **SMOOTH WALL PIPE SYSTEMS**

A. Material: PE 3408 per ASTM D2239 with a minimum cell classification of 345434C per ASTM D3350.

B. Pipe: Smooth wall inside and out with an SDR or working pressure rating indicated or accepted by ENGINEER with exterior markings as follows:

1. ASTM Standard Number.
2. Pipe Size.
3. Class and profile number.
4. Production code.
5. Standard dimension ratio.

C. Fittings:
1. Resin same as pipe.
2. Working pressure same or greater than pipe.

D. Joints:
1. Thermally welded butt fusion, ASTM D3261.
2. Flanged, ASTM D2657.
3. Ultra high molecular weight electo-fusion tape with a polyethylene coupler meeting ASTM F1055 requirements.

2.2 **CORRUGATED WALL PIPE SYSTEMS**

A. Material: Polyethylene, ASTM D3350 with a cell class as required in AASHTO M252, AASHTO M294 or AASHTO MP7-97

B. Pipe: Type S or D unless indicated elsewhere.

C. Fittings:
1. Blow molded with cell class 335420C, ASTM D3350.
2. Rotational molded with cell class 213320C, ASTM D3350.
3. Shop or field remanufactured of the same material as the pipe

D. Joints:
1. Bell and spigot with gaskets, ASTM F477. Foam type weather stripping not allowed.
2. Split corrugated couplings with plastic or stainless steel ties and leak resistant neoprene gasket.

2.3 **NUTS AND BOLTS**

A. Carbon steel machined heavy hex heads, Class 2 fit, ASTM A307; Grade B, threads, ASME B1.1.

PART 3 EXECUTION

3.1 INSTALLATION

A. Assembly: Abide by manufacturer's instructions and the following. Use the more stringent provisions if there are any conflicts.

1. Pressurized Systems:
   a. Water distribution and transmission, Section 33 11 00.
   b. Underground irrigation, Section 32 84 23.
2. Gravity Systems:
   a. Sanitary sewers, Section 33 31 00.
   b. Under drains and storm drains, Section 33 41 00.

B. Burial: Comply with Section 33 05 20 and the following. Use the more stringent provisions if there are any conflicts.

1. ASTM D2774 for pressure pipe systems.
2. ASTM D2321 for gravity pipe systems.
3. Protect ferrous materials with polyethylene sheet that is at least six (6) mil thick. Tape wrap the sheet around the pipe.

END OF SECTION

SECTION 33 05 07
POLYVINYL CHLORIDE PIPE

PART 1 GENERAL

1.1. **SECTION INCLUDES**

A. Polyvinyl chloride pipe, couplings, fittings and joint materials.

1.2 **REFERENCES**

A. **ASTM Standards**:

D1784 Rigid Poly (Vinyl Chloride) (PVC) Compounds and Chlorinated Poly (Vinyl Chloride) (CPVC) Compounds.

D2241 Poly (Vinyl Chloride) (PVC) Pressure Rated Pipe (SDR - Series).

D2321 Underground Installation of Flexible Thermoplastic Sewer Pipe.

D2412 Determination of External Loading Characteristics of Plastic Pipe by Parallel-Plate Loading.

D2564 Solvent Cement for Poly(Vinyl Chloride) (PVC) Plastic Pipe and Fittings.

D2729 Poly(Vinyl Chloride) (PVC) Sewer Pipe and Fittings.

D2774 Underground Installation of Thermoplastic Pressure Piping.

D2855 Making Solvent Cemented Joints with Poly(Vinyl Chloride) (PVC) Pipe and Fittings.

D3034 Type PSM Poly(Vinyl Chloride) (PVC) Sewer Pipe and Fittings.

D3139 Joints for Plastic Pressure Pipes Using Flexible Elastomeric Seals.

D3212 Joints for Drain and Sewer Plastic Pipes Using Flexible Elastomeric Seals.

F656 Primers for Use in Solvent Cement Joints of Poly(Vinyl Chloride) (PVC) Plastic Pipe and Fittings.

F679 Poly(Vinyl Chloride) (PVC) Large-Diameter Plastic Gravity Sewer Pipe and Fittings.

F949 Poly(vinyl Chloride) (PVC) Corrugated sewer Pipe with a Smooth Interior and Fittings.

B. **AWWA Standards**:

C110 Ductile-Iron and Gray-Iron Fitting, 3 inches Through 48 inches, for Water and Other Liquids.

C900 Polyvinyl Chloride (PVC) Pressure Pipe, 4 In. Through 12 In., for Water Distribution.

C905 Polyvinyl Chloride (PVC) Pressure Pipe and Fabricated Fittings, 14 In. Through 48 In.

C909 Molecularly Oriented Polyvinyl Chloride (PVCO) Pressure Pipe, 4 in. Through 24 In., for Water, Wastewater, and Reclaimed Water Service.

1.3 **DEFINITIONS**

A. **Standard Dimension Ratio (SDR):** Outside diameter of pipe divided by wall thickness.

1.4 **QUALITY ASSURANCE**

A. Evaluate pipes that show damage such as dents, cuts, cracks, breaks, fractures, or distortions. Recommend appropriate action. ENGINEER may require CONTRACTOR provide certification by a professional engineer competent in the structural design of the pipe material for action recommended.

PART 2 PRODUCTS

2.1 **PRESSURE PIPE SYSTEM**

A. Pipe: AWWA C900, C905, or C909 as applicable. Use outside diameters defined by ductile iron pipe sizes. Dimensions, class, SDR, and tolerances per ASTM D2241.

B. Compounds: Type 1, Grade 1, Class 12454A, ASTM D1784.

C. Joints:

1. Bell and spigot with flexible elastomeric seals, ASTM D3139. Use non-toxic lubricant.
2. Solvent weld, ASTM D2564.

D. Fittings (4 inch and larger): Ductile iron Class 250, ASTM C110.

2.2 **GRAVITY PIPE SYSTEM**

A. Pipe:

1. Solid smooth wall:
   a. 4 to 15 inch diameter, ASTM D3034.
   b. 18 to 27 inch diameter, ASTM F679.
2. Corrugated wall with a smooth interior, 4 to 10 inches diameter, ASTM F949.

B. Fittings: ASTM D1784.

C. Stiffness: 50 psi minimum when measured at five (5) percent deflection, ASTM D2412.

D. Additives and Fillers: Not to exceed 10 parts by weight; 100 parts of resin in the compound.

E. Joints: Bell and spigot with flexible elastomeric seals, ASTM D3212.

F. Flattening: No visual evidence of splitting, cracking, or breaking when

flattened to 60 percent deflection, ASTM D2412.

2.3 **PERFORATED PIPE SYSTEM**

A. Pipe: Refer to gravity pipe products above.

B. Perforations: ASTM D2729.

C. Joints: Push-on, solvent weld or other.

2.4 **SOLVENT WELDS**

A. Primer, ASTM F656.

B. Glue, ASTM D2564.

PART 3 EXECUTION

3.1 **INSTALLATION**

A. Assembly: Abide by manufacturer's instructions and the following. Use the more stringent provisions if there are any conflicts.

1. Pressurized Systems:

a. Water distribution and transmission, Section 33 11 00, AWWA C900, C905, and C909.

b. Underground irrigation, Section 32 84 23, and ASTM D2855.

2. Gravity Systems:

a. Sanitary sewers, Section 33 31 00.

b. Under drains and storm drains, Section 33 41 00.

B. Burial: Comply with Section 33 05 20 and the following. Use the more stringent provisions if there are any conflicts.

1. ASTM D2774 for pressure pipe systems.

2. ASTM D2321 for gravity pipe systems.

END OF SECTION

SECTION 33 05 11
POLYPROPYLENE PIPE

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Polypropylene (PP) pipe, fittings, joint requirements, and installation.

1.2 REFERENCES

A. **AASHTO Standards**:

M330 Polypropylene Pipe, 300 to 1500 mm (12 to 60 in.) Diameter.

NTPEP National Transportation Product Evaluation Program.

B. **ASTM Standards**:

D 2321 Underground Installation of Thermoplastic Pipe for Sewers and Other Gravity Flow applications.

D 2774 Underground installation of Thermoplastic pressure piping.

D 3212 Joints for Drain and Sewer Plastic Pipes Using Flexible Elastomeric Seals.

F 477 Elastomeric Seals (Gaskets) for Joining Plastic Pipe.

F 2389 Pressure-rated Polypropylene (PP) Piping Systems.

F 2736 6 to 30 in. Polypropylene (PP) Corrugated Single Wall Pipe and Double Wall Pipe.

F 2764 30 to 60 in. Polypropylene (PP) Triple Wall Pipe and Fittings for Non-Pressure Sanitary Sewer Applications.

F 2881 12 to 60 in. Polypropylene Dual Wall Pipe and Fittings for Non-Pressure Storm Sewer Applications.

1.3 DEFINITIONS

A. Corrugated Wall PP Pipe Classifications: Classified as Types C, Type S, and Type D. See Section 33 05 06.

B. Porous Corrugated Wall PP Pipe Classification: Classified as follows.

1. Type CP - This is Type C pipe with perforations.
2. Type SP - This is Type S pipe with perforations.

1.4 SUBMITTALS

A. Certificate showing product compliance per AASHTO NTPEP.

PART 2 PRODUCTS

2.1 PIPE

A. **General**: Pressurized and non-pressurized pipe may be required in a PP pipe system. ENGINEER to select if not specified elsewhere.

B. **Sanitary Sewer Pipe**:

1. Type S (corrugated single wall) per ASTM F 2736 (6-30") or
2. Type D (corrugated double wall) per ASTM F 2764 (30-60").

C. **Storm Drain Pipe**: Type S per ASTM F 2881 (12-60").

D. **Under Drain Pipe**: Type C, S, CP, or SP. Type CP and SP have Class 1 or Class 2 perforations indicated in AASHTO M 330. Provide Class 2 perforations if not indicated elsewhere. Class 1 perforations are for pipe intended to be used for under drains or combination under drain and storm drain. Class 2 perforations are for pipe intended to be used for under drains.

E. **Pressurized Pipe**:

1. Solid smooth wall, ASTM F 2389.
2. Working pressure rating indicated or accepted by ENGINEER.
3. Minimum exterior markings as follows.
   a. ASTM Standard Number.
   b. Pipe Size.
   c. Production Code.

2.2 JOINTS

A. **General**: Provide joints with a working pressure at least equal to or greater than the pipe's working pressure and acceptable to ENGINEER.

B. **Storm Drain and Sanitary Sewer Joints**: Bell and spigot meeting ASTM D 3212 with gasket that complies with ASTM F 477. Other joining methods such as external snap couplers, split couplers, solvent welding, etc. must meet performance requirements herein, manufacturer's recommendations, and ENGINEER's review.

1. When using bell retaining bands, use corrosive resistant materials such as fiberglass or stainless steel.
2. Foam type weather stripping not allowed.

C. **Under Drain Joints**: If not water tight, wrap with geotextile and tape to prevent detritus entry.

D. **Pressurized Joints**: ASTM F 2389.

2.3 FITTINGS

A. Supplied or recommended by pipe manufacturer.

B. Structural and pressure performance same as pipe or greater.

C. Vacuum test certified by manufacturer.

2.4 **VALVES, MANIFOLDS, ETC.**

A. ASTM F 2389.

PART 3 EXECUTION

3.1 **INSTALLATION**

A. **Assembly**: Abide by manufacturer's instructions and the following. Use the more stringent provisions if there are any conflicts.

1. Pressurized Systems:
   a. Water distribution and transmission, Section 33 11 00.
   b. Underground irrigation, Section 32 84 23.
2. Gravity Systems:
   a. Sanitary sewers, Section 33 31 00.
   b. Under drains and storm drains, Section 33 41 00.

B. **Burial**: Comply with Section 33 05 20 and the following.

1. ASTM D 2774 for pressure systems.
2. ASTM D 2321 for gravity systems.

END OF SECTION

SECTION 33 05 14
UTILITY GRADE ADJUSTMENT

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Raise, lower, or change slope of Street Fixtures.

B. Install Cover Collars.

C. This specification is NOT APPLICABLE to raising and lowering Street Fixtures that withstand internal pressure.

1.2 REFERENCES

A. **APWA (Utah) Standards**.

Plan 273	Frame and cover for monument
Plan 360	Grade ring
Plan 362	Cover collar for storm drains
Plan 413	Cover collar for sanitary sewer manhole
Plan 574	Cover collar for water valve box

1.3 DEFINITIONS

A. **Box**: A structure such as a valve box, meter box, monument box, fire hydrant box, electrical pull box, cleanout box or other like structure not intended for human entry.

B. **Cover Collar**: A concrete filled annular space between the frame of a Street Fixture and the adjacent pavement surface usually one (1) foot wide.

C. **Extension Ring**: A concrete or metal ring used to adjust surface elevations and surface cross slopes of Street Fixtures covers. Metal rings are used between metal frames and metal covers or grates. Concrete rings are used below metal frames or in the concrete structure below.

D. **Manhole**: A structure designed to permit human entry and working space inside and to confine and control the flow of pipe-conveyed fluids. These structures are collectively referred to as manholes regardless of composition, design, type or depth.

E. **Street Fixture**: The top of existing structures such as but not limited to Manholes, catch basin, sumps, inlets, valve boxes, meter boxes, monument boxes, and similar structure in a thoroughfare surface.

F. **Vault**: A structure intended for human entry containing electrical or telephone facilities or other like utilities.

PART 2 PRODUCTS

2.1 PAVEMENT

A. Bituminous Concrete: Unless indicated otherwise in the Bid Documents or by ENGINEER, provide PG64-22, DM-1/2, 50 blow, product per Section 32 12 05.

B. Concrete: Class 4000 cast-in-place, Section 03 30 04.

2.2 GROUT

A. Portland cement grout, Section 03 61 00.

2.3 EXTENSION RINGS

A. Metal: APWA 273.

B. Concrete or plastic: APWA Plan 360..

PART 3 EXECUTION

3.1 PREPARATION

A. Determine condition of existing incidental structure. Any item not reported damaged before construction shall be considered unbroken and must be replaced by CONTRACTOR at no additional cost to OWNER.

B. Provide Invert Cover over pipe in cleanout box to prevent gravel, concrete, or debris from entering pipeline.

C. Unless required otherwise, arrange for utility companies to adjust their own structures.

D. Coordinate all adjustments with requirements of affected utility company.

3.2 ADJUST STRUCTURE TO GRADE

A. Restrict excavation around structure to a minimum.

B. After structure adjustment, backfill void around structure and compact before paving or landscaping.

C. Apply mortar to inside and outside of concrete grade rings.

D. If the cone is cracked during construction, restack the manhole with shorter manhole sections and install a new cone at no additional cost to the OWNER.

3.3 ADJUST COVER IN PAVEMENT SURFACE

A. Method A - Metal extension rings:

1. Use rings that lock together.
2. Set frame at desired elevation and cross-slope.
3. Seal joints between pavement and ring, Section 32 01 17.

B. Method B – Concrete extension rings:
   1. Place concrete grade rings under frame or in structure riser shaft.
   2. Set frame at desired elevation and cross-slope.
   3. Provide 100 percent concrete support under frame. Do not use wood, bricks, concrete fragments, blocks or particles as support.
   4. Grout seams between concrete rings and between frame and concrete rings.

C. Method C – Place Concrete:
   1. Set frame at desired elevation and cross-slope.
   2. Place concrete and provide 100 percent concrete support under frame.

D. Method D – Concrete Deck:
   1. Remove existing concrete deck.
   2. Reset steel rebar.
   3. Set frame to grade, set forms.
   4. Pour concrete. Provide complete concrete support under Street Fixtures.

3.4 INSTALL COVER COLLAR

A. Follow APWA Plans 362, 413, or 574 requirements as applicable..

B. Open annular space between pavement and Street Fixtures cover. Unless indicated otherwise, make space 12 inches wide.

C. Set concrete collar to 1/4 inch minimum to 1/2 inch maximum below bituminous concrete pavement surface and 1/4 inch below Portland cement concrete pavement surface.

D. Trowel finish, Section 03 35 00.

3.5 SURFACE FINISHING

A. In new streets or overlays, adjust Street Fixture covers after paving is complete.

B. Restore paved surfaces, Section 33 05 25.

C. Landscapes: Restore landscaping as indicated and as follows where applicable.
   1. Section 32 92 00 for turf and grasses.
   2. Section 32 93 13 for other ground cover.

D. Repair public and private facilities damaged by CONTRACTOR.

END OF SECTION

SECTION 33 05 20
BACKFILLING TRENCHES

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Backfill materials in trenches and backfilling requirements.

1.2 REFERENCES

A. **APWA (Utah) Standards**:

Plan 381 Trench backfill

Plan 382 Pipe zone backfill

B. **ASTM Standards**:

D698 Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft-lbf/ft^3 (600 kN-m/m^3)).

D1557 Laboratory Compaction Characteristics of Soil using Modified Effort (56,000 ft-lbf/ft^3 (2,700 kN-m/m^3)).

D2922 Density of Soil and Soil-Aggregate in Place by Nuclear Methods (Shallow Depth).

D4832 Preparation and Testing of Soil-Cement Slurry Test Cylinders.

1.3 DEFINITIONS

A. **Bedding**: That surface of the excavation or portion of the Pipe Zone below the pipe.

B. **Pipe Zone**: That zone in a backfilling operation which supports, and surrounds the pipe barrel, and extends to 1 foot above the top of the pipe barrel.

1.4 SUBMITTALS

A. Submit maximum laboratory dry density and optimum laboratory moisture content for:

1. Subgrade material, and
2. Each type of fill to be used.

B. Submit aggregate batch delivery tickets showing name of material source, serial number of ticket, date and truck number, name of Supplier, job name and location, volume or weight. And aggregate classification or Supplier’s identification code.

1.5 QUALITY ASSURANCE

A. Do not change material sources, or aggregate without ENGINEER's knowledge.

B. Reject backfill material that does not comply with requirements in this Section.

C. If requested, submit a quality control inspections and testing report describing source and field quality control activities performed by CONTRACTOR and Suppliers.

1.6 **STORAGE**

A. Safely stockpile backfill materials.

B. Separate differing materials, prevent mixing, and maintain optimum moisture content of backfill materials.

1.7 **SITE CONDITIONS**

A. Do not place, spread, or roll any backfill material over material that is damaged by water. Remove and replace damaged material at no additional cost to OWNER.

B. Control traffic and erosion. Keep area free of trash and debris. Repair settled, eroded, and rutted areas.

C. Reshape and compact damaged structural section to required density.

D. Restore any damaged structure to its original strength and condition.

E. Replace contaminated backfill at no additional cost to OWNER.

1.8 **SEQUENCING**

A. Coordinate backfilling operation with pipeline commissioning, Section 33 08 00.

1.9 **ACCEPTANCE**

A. General: Native material may be wasted if there is no additional cost to substitute material acceptable to ENGINEER.

B. Material: For material acceptance refer to:

1. Common fill, Section 31 05 13.
2. Aggregate base course, Section 32 11 23.
3. Cement treated fill, Section 31 05 15.

C. Lift Thickness: One test per lot.

D. Compaction: One test per lot. Verify density using nuclear tests, ASTM D2922. Compaction standard and Lot sizes as follows:

Table 1: Compaction Standard and Lot Size

Material	Proctor	Lot Size
Subgrade	Standard	200 linear feet
Common Fill	Standard	200 linear feet per lift 25 square feet of footing area per lift
Aggregate base course	Modified	200 linear feet per lift 25 square feet of footing area per lift

NOTES
(a) Standard proctor, ASTM D698.
(b) Modified proctor, ASTM D1557.
(c) Lift thickness above pipe zone before compaction, 8 inches.

E. Flowable Fill Strength: Lot size is one (1) day production with sub-lots

of 50 cubic yards or part thereof. Verify strength using cylinders, ASTM D4832.

F. Grade, Cross Slope: Measured at random locations.

1.10 **WARRANTY**

A. Correct any settlement of Trench backfill or structures built over Trench backfill at no cost to OWNER.

B. Restore structures damaged by settlement at no additional cost to OWNER.

PART 2 PRODUCTS

2.1 **BACKFILL MATERIALS**

A. Common fill, Section 31 05 13. Granular material, CONTRACTOR's choice.

B. Aggregate base course, Section 32 11 23. Untreated base course.

C. Cement treated fill, Section 31 05 15. Use a flowable fill so vibration is not required.

D. Slag or bitumen bearing material NOT ALLOWED in trench.

2.2 **WATER**

A. Make arrangements for sources of water during construction and make arrangements for delivery of water to site.

B. Comply with local Laws and Regulations at no additional cost to OWNER when securing water from water utility company.

2.3 **GEOTEXTILE FABRIC**

A. Section 31 05 19. Use woven or non-woven stabilization-separation fabric. Select either moderate MARV or high MARV as needed.

2.4 **IDENTIFICATION TAPE**

A. Permanent, bright colored, continuous printed magnetic plastic tape, intended for direct burial service; not less than six (6) inches wide by four (4) mils thick. Tape shall read "**CAUTION: BURIED INSTALLATION BELOW**". Color as follows.

Red	Electric power lines, cables, conduit and lighting cables
Yellow	Gas, oil, steam, petroleum or gaseous materials
Orange	Communications, alarm, signal, cables or conduits
Blue	Potable water
Purple	Reclaimed water, irrigation and slurry lines
Green	Sewer and storm drain lines

PART 3 EXECUTION

3.1 PREPARATION

A. Implement traffic control plan requirements, Section 01 55 26.

B. Identify required line, levels, contours, and datum.

C. Stake and flag locations of underground utilities.

D. Verify:

1. Backfill material meets gradation requirements.
2. Foundation walls are braced to support surcharge forces imposed by backfilling operations, areas to be backfilled are free of debris, snow, ice or water.
3. Trench bottom is not frozen.

E. If ground water is in the intended backfill zone, dewater.

3.2 SUBGRADE

A. Protect subgrade from desiccation, flooding, and freezing.

B. Before backfilling over Subgrade, get ENGINEER's review of Subgrade surface preparations.

C. If Subgrade is not readily compactable, get ENGINEER's permission to stabilize the subgrade:

1. Excavation for Subgrade stabilization is incidental work, Section 31 23 16.
2. Place geotextile fabric. Place acceptable fill in lifts. Compact.

3.3 PROTECTION

A. During installation or repair, plug end of pipe or fitting except when installing next section of pipe or fitting.

B. Movement of construction machinery over Work at any stage of construction is solely at CONTRACTOR's risk.

3.4 GENERAL BACKFILLING REQUIREMENTS

A. Avoid injuring and displacement of conduit, pipe and structures while compacting soil or operating equipment next to pipeline.

B. Place geotextile fabrics; Section 31 05 19.

C. Do not damage corrosion protection on pipe.

D. Repair or replace damaged pipe at no additional cost to OWNER.

E. Withdraw sheathing, shoring, piles, and similar supports as backfilling progresses. Backfill and compact all holes left by removals.

F. Provide sufficient water quality facilities to protect downstream fish and wildlife, and to meet State water quality requirements.

G. Water settling of trench backfill is not permitted. "Jetting" of trench backfill is prohibited.

3.5 PIPE ZONE

A. Follow APWA Plan 382 requirements.

B Maintain uniform foundation along barrel of pipe with sufficient relief for joint connections.

C. Use backfill materials meeting pipe manufacturer's recommendations. Maximum backfill particle size is 3/4 inch for plastic pipe.

D. Do not permit free fall of backfill material that may damage pipe, pipe finish, or pipe alignment.

E. Except where piping must remain exposed for tests, fill pipe zone as soon as possible.

3.6 **TRENCH ABOVE PIPE ZONE.**

A. Follow APWA Plan 381 requirements.

B. Maximum lift thickness before compaction is eight (8) inches.

C. Fill unauthorized excavations with material acceptable to ENGINEER at no additional cost to OWNER.

D. Do not damage adjacent structures or service lines.

E. Install continuous identification tape directly over buried lines 18 inches below finished grade.

3.7 **MODIFIED BACKFILL LAYER METHOD**

A. At discretion of CONTRACTOR, backfill may be placed in thicker layers than indicated above subject to the following provisions:

1. CONTRACTOR proves the ability of proposed method to achieve specified average compaction density.
2. ENGINEER, on the basis of test results, approves the system in writing.

B. Should CONTRACTOR find it necessary to change the method or any part of it, including the source of material, or the rate of placing the material, obtain approval of ENGINEER, who may require a further trial area.

C. If testing shows a previously approved system is no longer producing the required degree of compaction, make changes to comply.

D. Where vibration effects are creating environmental problems, make changes to eliminate problems.

3.8 **TOLERANCES**

A. Compaction: Ninety-five (95) percent or greater relative to a standard or modified proctor density, Section 31 23 26.

B. Lift Thickness (before compaction):

1. Eight (8) inches when using riding compaction equipment.
2. Six (6) inches when using hand held compaction equipment.
3. As proven in the modified backfill layer method.

C. Cement Treated Fill: Compressive strength targets are 60 psi in 28 days and 90 psi maximum in 28 days.

3.9 **FIELD QUALITY CONTROL**

A. Test trench backfilling until a compaction pattern acceptable to CONTRACTOR and ENGINEER is achieved. Continue random quality control compaction testing.

3.10 SURFACE FINISHING

A. Provide temporary paved surfaces where trenches pass through roadways, driveway approaches or sidewalks.

B. Restore paved surfaces, Section 33 05 25.

C. Landscapes: Restore landscaping as indicated and as follows where applicable.

1. Section 32 92 00 for turf and grasses.
2. Section 32 93 13 for other ground cover.

D. Repair public and private facilities damaged by CONTRACTOR.

3.11 CLEANING

A. Remove stockpiles from site when work is complete. Grade site to prevent free standing surface water.

B. Leave borrow areas clean and neat.

END OF SECTION

SECTION 33 05 25
PAVEMENT RESTORATION

PART 1 GENERAL

1.1 **SECTION INCLUDES**

A. Aggregate base restoration.

B. Concrete base restoration.

C. Pavement surface restoration.

1.2 **REFERENCES**

A. **APWA (Utah) Standards**:

Plan 255 Bituminous pavement T-patch.

Plan 256 Concrete pavement patch.

B. **ACI Standards**:

305 Hot Weather Concreting.

306 Cold Weather Concreting.

C. **ASTM Standards**:

A615 Deformed and Plain Billet-Steel Bars for Concrete Reinforcement.

C928 Packaged, Dry, Rapid- Hardening Cementitious Materials for Concrete Repairs.

C1315 Liquid Membrane Forming Compounds Having Special Properties for Curing and Sealing Concrete.

D4 Bitumen Content.

D5 Penetration of Bituminous Materials.

D92 Flash and Fire Points by Cleveland Open Cup.

D95 Water in Petroleum products and Bituminous Materials by Distillation.

D113 Ductility of Bituminous Materials.

D402 Distillation of Cut-Back Asphaltic (Bituminous) Products.

D1664 Coating and Stripping of Bitumen-Aggregate Mixtures.

D2041 Theoretical Maximum Specific Gravity of Bituminous Paving Mixtures.

D2170 Kinematic Viscosity of Asphalts (Bitumens).

1.3 SUBMITTALS

A. Traffic control plan, Section 01 55 26.

B. Target sieve gradation for aggregate base.

C. Bituminous pavement mix design.

D. Portland cement concrete mix design and data sheets for joint filler board, concrete joint sealer, concrete bond breaker, concrete chemical additives, curing agent, and reinforcement.

1.4 WEATHER

A. Bituminous Pavement Restoration:

1. If air and roadbed temperatures in the shade are less than 40 deg F placement is considered a temporary patch.
2. Remove any temporary patching and provide permanent patch material when temperature exceeds 40 deg F. CONTRACTOR may perform work after cold weather season if authorized in writing by ENGINEER.

B. Portland Cement Concrete Pavement Restoration:

1. Hot weather, ACI 305. Set retarding admixture may be used if allowed in mix design. Discontinue placement if ambient air temperature exceeds 100 deg F. in the shade.
2. Cold weather, ACI 306. Concrete accelerating admixtures may be used if allowed in mix design. Provide weather protection until 90 percent of design compressive strength. When removing heat, limit temperature change next to concrete surface to 20 deg F. per 12 hours until the concrete surface temperature reaches ambient.
   a. Use of admixtures or curing agent will not relax cold weather placement and cure requirements.
   b. Do not use chemical additives to prevent freezing.
   c. Prevent loss of moisture during protection.

1.5 ACCEPTANCE

A. Aggregate Base: Compaction.

B. Concrete Base: Strength.

C. Bituminous Pavement:

1. Compaction.
2. Grade and cross slope of pavement surface.
3. Surface distortion.

D. Concrete Pavement:

1. Reinforcement placement and concrete strength.
2. Grade and cross slope of pavement surface.
3. Surface distortion.

PART 2 PRODUCTS

2.1 MATERIALS

A. Aggregate Base: Untreated base course material, Section 32 11 23.

B. Flowable Fill Base: Section 31 05 15.

C. Portland Cement Concrete Base Course: Class 4000, Section 03 30 04.

D. Tack Coat: Grade SS-1, Section 32 12 13.13.

E. Permanent Marking: Tape or paint, Section 32 17 23.

2.2 BITUMINOUS PAVEMENT

A. Permanent Warm Weather Bituminous Concrete: PG64-22, DM-1/2, 50 blow, Section 32 12 05 unless indicated elsewhere.

B. Temporary Cold Weather Bituminous Concrete Patching Material: Type MC250, DM-1/2, 50 blow, Section 32 12 05 with hydrated lime or anti-strip agent as indicated in the mix design.

C. Pavement Sealing:

1. Slurry Seal: SS Type II - RS-1, Section 32 01 13.61.
2. Chip Seal: MC-250. CS-A, Section 32 01 13.64.
3. Fog Seal: Section 32 01 13.50.

2.3 CONCRETE PAVEMENT

A Chairs, Bolsters, Bar Supports, Spacers: Section 03 20 00.

B. Bond Breaker: Paraffin wax, lithium grease, or other semi-solid, inert lubricant.

C. Fillers and Sealer: Section 32 13 73:

1. Expansion joint filler, F1 sheet 1/2 inch thick.
2. Contraction joint filler, closed cell Type 1 round backer rod.
3. Contraction joint sealer, HAS1 or HAS4 hot applied.

D. Adhesive Grout: Epoxy gel type II; Section 03 61 00.

E. Reinforcement: Grade 60 ksi galvanized or epoxy coated steel, ASTM A615:

1. Dowel Bar: Smooth.
2. Tie Bar: Deformed.
3. Mat: Deformed.

F. Normal Set Concrete: Class 4000, Section 03 30 04. Slump range per mix design.

G. High Early Strength Concrete: Quick set.
   1. Slump range per mix design, Section 03 30 04:
   2. Concrete compressive strength of 3,000 psi minimum in four (4) hours.
   3. Cementitious Material: Rapid hardening or very rapid hardening, ASTM C928.
   4. Cement content of mix, per cement manufacturer's recommendations or approved mix design.
   5. Non-reactive aggregates in applications subjected to wetting, extended exposure to humid atmosphere, or contact with moist ground.

H. Curing and Sealing Compound: Membrane type, ASTM C1315:
   1. Type II Class A or B (white pigmented) for roadway pavement.
   2. Clear with red fugitive dye for concrete flat work.

PART 3 EXECUTION

3.1 CONSTRUCTION EQUIPMENT

A. Paver: Use bituminous concrete lay-down machine for final lift if surface restoration is over a trench in the direction of traffic flow or if trench is a wide surface excavation.

3.2 PREPARATION

A. Implement traffic control plan requirements, Section 01 55 26.

B. At site, post name, address and telephone number of CONTRACTOR to contact in emergencies.

C. Notify ENGINEER within 24 hours of commencing work of this Section but not less than four (4) hours.

D. Cutting Pavements: Cut full depth and straight, Section 02 41 14. Remove all bonding inhibitors.

3.3 AGGREGATE BASE

A. Match depth of existing aggregate base or at least eight (8) inches thick.

B. Place lifts not exceeding eight (8) inches before compaction. Compact each lift to 95 percent or greater relative to a modified proctor density.

3.4 CONCRETE SUBSTRATE

A. Match existing substrate thickness.

B. Apply concrete bonding compound, Section 03 30 10, to edge of existing concrete.

C. Place concrete, Section 03 30 10.

3.5 BITUMINOUS PAVEMENT RESTORATION

A. APWA Plan 255.

B. Match existing pavement thickness plus 1 inch, but not less than four (4) inches. Maximum thickness is six (6) inches in residential areas and eight (8) inches in non-residential areas.

C. Clean all vertical surfaces that butt against new patchwork. Provide full coverage spray tack coat. Do not spray tack coat on surfaces exposed to public view. Do not apply tack coat by brush.

D. Place bituminous pavement in lifts not less than three (3) inches after compaction. Compact to 94 percent of ASTM D2041 (Rice density) plus or minus two (2) percent.

E. Match adjacent surface slopes.

F. Use lay-down machine for final lift if trench is in direction of traffic flow.

3.6 CONCRETE PAVEMENT RESTORATION

A. Full Depth Restoration:

1. APWA Plan 256.
2. In vertical load bearing joints, clean vertical surfaces and install tie-bars or dowels. Apply concrete bonding compound, Section 03 30 10.
3. Place concrete. Prevent segregation.
4. Match adjacent surface slopes. Match adjacent surface texture.
5. Saw cut contraction joints.

B. Partial Depth Restoration:

1. Chip, hydro-blast or saw cut concrete at least one (1) inch deep.
2. Make surfaces free of frost, ice, mud, water, grease, dirt and other materials that hamper bonding.
3. Install bonding agent per manufacturer's recommendations.
4. Place concrete. Prevent segregation.
5. Match adjacent surface slopes. Make surface texture match existing.

C. Cure:

1. Apply membrane forming compound immediately after placement to protect work from hot or cold weather. Apply total coverage in two (2) directions after texturing. Provide ASTM C1315 and Section 03 39 00
2. Eliminate thermal shock of concrete by keeping cure temperature even throughout extent and depth of concrete patch.

D. Traffic: Not allowed on the repaired area until concrete strength is achieved.

3.7 CONCRETE PAVERS

A. Screed bedding with a notched and cambered screed board to achieve a crown between existing pavers. Use graded aggregate, geotextile, and bedding sand, Section 32 14 13.

B. After placement, use a plate-type vibrating compactor to compact pavers. Size compactor to provide at least 5,000 lbf force. Sweep joint sand into the joints and vibrate until joints are full. Remove excess joint sand.

C. Match adjacent surface grades with no more than 1/4 inch vertical deviation in 10 feet.

3.8 TOLERANCE

A. 1/4 inch vertical deviation from design elevation in 10 feet.

B. Match adjacent surface slopes.

3.9 PAVEMENT MARKINGS

A. Unless indicated otherwise, repair all damaged Pavement markings with matching material types and installation.

3.10 REPAIR

A. Remove bumps and depressions exceeding 1/4 inch vertical deviation in 10 feet.

B. Bituminous Pavement: Repair options include mill and inlay, or grinding. Feather edges on bituminous concrete repairs are not allowed. Apply a cationic or anionic tack emulsion to make milled surfaces water resistant.

C. Concrete Pavement: Repair options include grinding, or slab replacement. Apply a water repelling product over surfaces that are ground to make the surfaces water resistant. Repair or replace any slab that cracks, shrinks, or otherwise fails. Do not allow traffic on repaired area until concrete strength is achieved.

END OF SECTION

SECTION 33 08 00
COMMISSIONING OF WATER UTILITIES

PART 1 GENERAL

1.1 **SECTION INCLUDES**

A. Tests to be performed for commissioning pressurized and non-pressurized water piping systems.

B. Warning: DO NOT use hydrostatic pressures for air-pressure testing.

1.2 **REFERENCES**

A. **ASTM Standards**.

C497 Testing Concrete Pipe, Sections, or Tile

C969 Infiltration and Exfiltration Acceptance Testing of Installed Precast Concrete Pipe Sewer Lines

C1103 Joint Acceptance Testing of Installed Precast Concrete Pipe Sewer Lines

C1214 Test Method for Concrete Pipe Sewerlines by Negative Air Pressure (Vacuum)

F1417 Installation Acceptance of Plastic Non-pressure Sewer Lines Using Low-Pressure Air

F2497 Infiltration and Exfiltration Acceptance Testing of Installed Corrugated High Density Polyethylene Pipelines

B. **NASSCO Standards**.

PACP Pipe Condition Assessment Using CCTV.

1.3 **DEFINITIONS**

A. **CCTV**: Acronym for closed-circuit television.

B. **Leakage**: The quantity of water required to maintain specified hydrostatic test pressure after pipeline has been filled with water and air expelled.

C. **Non-rigid Pipe**: Any pipe that requires bedding and pipe zone backfill material for sturctural support to prevent distortion that may be caused by dditional backfill placement.

D. **PACP**: Acronym for pipeline assessment certification program. This program is provided by the National Association of Sewer Service Companies (NASSCO).

1.4 **SUBMITTALS**

A. **CCTV Report**: Include the following.

1. CCTV personnel are NASSCO PACP certified.
2. NASSCO PACP certified database and electronic worksheets accompany all progress inspection work.

3. All ENGINEER and NASSCO PACP required header information must be fully and accurately entered on all CCTV reports.
4. Corrections to punch list items are submitted in report form prior to final payment.

B. **Commissioning Test Report**: Use the commissioning test schedule (Table 3 this section) which identifies tests to be performed for commissioning potable and non-potable water piping systems. For each test performed, submit the following information as applicable.

1. Type of test.
2. Project number and date of the report.
3. Size, type, location and length of pipe in test section.
4. Test pressure and time.
5. Written and still image documentation of locations where deflection deviations, joint gaps, pipe damage, and any other deficiencies are observed.
6. Statement of whether mandrel was or was not able to pass.
7. Amount of leakage versus allowable.
8. Date of test approval.
9. Signature of test supervisor.
10. Signature of Resident Project Representative witnessing the test.

1.5 PROJECT CONDITIONS

A. CCTV: Run water through subject test system prior to video inspection. Conduct inspection prior to installation of paved surfaces. ENGINEER to be present during video inspection.

1. Record vertical and horizontal deviations, joint gaps, cracks, and pipe damage.
2. Video the entire circumference at each joint. Zoom where necessary.
3. Video image must be clear, continuously illuminated, focused, free from roll, static, or other image distortion qualities.
4. Identify the date, pipe reach, slope, upstream and downstream manhole numbers, and manhole to manhole footage.
5. Provide video inspection log as a computerized data report with a map of the system inspected with appropriate identification labels and still images of defects discovered in the video.
6. Repeat unsatisfactory inspections at no additional cost to OWNER.

B. Manual inspections are to be done by ENGINEER.

1.6 WARRANTY

A. At the end of the one year correction period repeat any test requested by ENGINEER to verify warranty of pipeline performance.

B. OWNER will pay for the cost of additional test inspections if pipe tests meet criteria in this section.

PART 2 PRODUCTS

2.1 TESTING MATERIALS

A. Medium: Water, air.

PART 3 EXECUTION

3.1 CONSTRUCTION EQUIPMENT

A. Leakage Recording Equipment:
   1. Supply all equipment and power to perform leakage testing.
   2. Secure approval of pressure and vacuum gages.
   3. Locate all gages and recording equipment away from affect of sunshine or unsuitable weather conditions.
   4. Place, vents, taps and drains for the test. Repair pipeline at completion of test at no additional cost to OWNER.

B. CCTV:
   1. Video operator is currently NASSCO PACP certified.
   2. Camera is to be crawler mounted meeting the following.
      a. Head is in the pipe diameter center with lighting sufficient to produce a clear picture of the entire periphery of the pipe.
      b. Pan and tilt to a 90 degree angle with the axis of the pipe.
      c. Rotate 360 degrees.
      d. Crawl at a speed no greater than 30 feet per minute.
   3. For pipe lateral replacements constructed by bursting, operate video camera in presence of Project Representative.

C. Mandrel:
   1. Diameter whether it is fixed or variable size must be verified with a proving ring or other method according to manufacturer's guideline.
   2. Contains at least nine equally spaced runners.
   3. Length not less than the diameter.
   4. Pulled (not pushed) through pipe.
   5. Recommend an alternate method of measurement if mandrel testing would cause damage to internal pipe coating.

3.2 PREPARATION

A. Notify ENGINEER 48 hours in advance of test.

B. Carry out selected tests as pipeline construction progresses to ensure construction methods are producing satisfactory results.

C. Remove debris, sediment and other material from installed pipe before testing. Do not discharge or flush sand, gravel, concrete, debris or other foreign material into any existing pipeline system. Flushing with clean water only will be allowed but with minimal flows to eliminate exceeding capacities of receiving systems. Flushing into existing pressurized water systems is NOT ALLOWED.

3.3 GRADE AND ALIGNMENT TEST

A. Tolerances for pipe placement are as follows.

Table 1 - Grade and Alignment

Design Grade	Tolerances	
	Grade [(a)]	Alignment
Greater than 1%	1/2 inch in 10 feet	1" from true line
0.5 to 1%	1/4 inch in 10 feet	1" from true line
Less than 0.5%	1/4 inch in 100 feet	1" from true line

NOTES
(a) Grade does not result in a level or reverse sloping invert. Standing water is evidence of non-compliance.
(b) For culverts, increase tolerances by 50 percent.

3.4 JOINT TESTS

A. Gap: Evaluate each pipe joint with a gap exceeding allowance in the following table. Recommend appropriate corrective action according to manufacturer's recommendations.

Table 2 - Joint Gap

Pipe Diameter, inches	Allowance, maximum
Less than 12	(a)
12 - 36	0.75 inch
42 - 48	1.00 inch
54 - 90	1.25 inches
96 - 144	1.75 inches

NOTES
(a) In pipes less than 12 inches diameter, allowable separation is equal to or less than amount permitted by manufacturer.

B. Invert Elevation: Variation in invert elevation where pipe sections join shall not exceed 1/64 inch per inch of pipe diameter, or 1/4 inch maximum.

3.5 INFILTRATION TEST

A. Tolerance: 200 gallons per inch, per mile, per day maximum (EPA's standard for sanitary sewers is specified). If ground water table is less than two (2) feet above the crown of the pipe the infiltration test is not required.

B. Concrete Pipe: ASTM C969.

C. Plastic Pipe: ASTM F2497.

3.6 EXFILTRATION TEST

A. Preparation: Air test or hydrostatic test is CONTRACTOR's choice.

B. Air Test:

1. Plastic Pipe: ASTM F1417.
   a. For pipe up to 30 inches diameter, pressure drop is 0.5 psi.
   b. For pipe larger than 30 inches diameter, isolated joint test is 3.5 psi. Maximum pressure drop is 1.0 psi in 5 seconds.
2. Concrete Pipe:
   a. ASTM C1214 for concrete pipe 4" to 24" diameter.
   b. ASTM C1103 for concrete pipe 27" and larger.

C. Hydrostatic Test: Provide air release taps at pipeline's highest elevations and expel all air before the test. Insert permanent plugs after test has been completed.

1. Plastic Pipe: ASTM F2497.
2. Concrete Pipe: ASTM C497. Abide by Section 3 and Section 16 in the ASTM standard and applicable recommendations of manufacturer.

C. Locate and repair leakage and retest until leakage rate is less than allowable.

D. Repair any noticeable leakage even if total leakage is less than allowable.

3.7 DISTORTION TEST

A. **Concrete Pipe**: Maximum crack width is 0.1 inch. Provide photographs of all cracks for possible mitigation or monitoring purposes.

1. Record location of cracks smaller than 0.1 inch. ENGINEER will evaluate crack at end of one year correction period.
2. For cracks exceeding 0.01 inch, measure crack width and provide photographs for monitoring purposes during subsequent inspections.

B. **Plastic and Other Pipe**: Maximum internal diameter reduction in any plane measured full length of installation prior to pavement placement, and at the end of the correction period is as follows.

1. Polyvinyl chloride pipe, 7.5 percent.
2. High density polyethylene pipe, 5 percent.
3. Polypropylene pipe, 5 percent.
4. Ductile iron pipe, 3 percent.
5. Corrugated metal pipe, 7.5 percent.

3.8 OBSTRUCTION TEST

A. Maximum protuberance is 1 inch.

3.9 TRACER WIRE CONTINUITY TEST

A. Test all tracer wire sections for continuity.

3.10 COMMISSIONING TEST SCHEDULE

A. The following table identifies required commissioning tests.

Table 3 - Commissioning Test Schedule

		Alignment	Grade	Joint	Inffiltration	Exfiltration	Distortion	Obstruction	Disinfection	Tracer Wire
Gravity Irrigation Landscaping	(a)		●							
Pressure Irrigation Landscaping	(a,b,c)		●			●				
Sanitary Sewers	(b,c)	●	●	●	●	●	●	●		
Sub-drains			●				●	●		
Storm Drains	(c,d)	●	●	●	●	●	●	●		
Potable Water	(c,d,e)					●	●	●	●	
Non-potable water	(d)						●	●		●

NOTES

(a) All lateral pipes drain.

(b) Operational testing: Landscaping systems.

- Perform operational testing after hydrostatic test is complete, backfill is in place, and sprinkler heads are adjusted to final coverage.
- Demonstrate system meets coverage requirements and automatic controls function properly.
- Coverage requirements are based on operation of one (1) circuit at a time.

(c) Exfiltration test for pressure pipeline systems.

(d) Exfiltration when requested by ENGINEER or specified elsewhere.

(e) Legally dispose disinfection and flushing water and ensure no damage to the environment.

3.11 REPAIR

A. Repair pipeline system at no additional cost to OWNER until it passes commissioning tests.

END OF SECTION

3.13 COMMISSIONING

A. Before surface finishing, commission pipeline per Section 33 08 00. Provide sizes and types of equipment connections and fittings that match pipe materials when pressure testing system.

B. If paved surfaces must be kept open prior to commissioning, provide temporary paved surfaces.

3.14 SURFACE FINISHING

A. Roadway Trenches and Patches: Follow requirements in Section 33 05 25 and in the following Standard Plans:

1. APWA Plan 255 for bituminous concrete T-patch.
2. APWA Plan 256 for concrete pavement patch.

B. Landscapes: Restore landscaping as indicated and as follows where applicable.

1. Section 32 92 00 for turf and grasses.
2. Section 32 93 13 for other ground cover.

C. Repair public and private facilities damaged by CONTRACTOR.

3.15 CLEANING

A, Remove debris, concrete, or other extraneous material that accumulates in existing piping or structures.

B. Clean all pipelines after testing. Do not flush sand, gravel, concrete, debris or other materials into existing piping systems.

END OF SECTION

SECTION 33 11 11
RELOCATE WATER METERS AND FIRE HYDRANTS

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Relocate existing water meters or fire hydrants because of changes in grade or installation of new improvements that conflict with existing meter and hydrant locations.

1.2 REFERENCES

A. **APWA (Utah) Standards**:

Plan 546 Fire hydrant replacement or relocation.

B. **AWWA Standards**:

C203 Coal-Tar Protective Coatings and Linings for Steel Water Pipelines - Enamel and Tape – Hot-Applied.

C502 Dry-Barrel Fire Hydrants.

1.3 JOB CONDITIONS

A. Secure utility company permit to do relocation work and pay applicable fees.

B. Secure utility company approval of joints, connections, and pipe installations before commencing backfill operations.

PART 2 PRODUCTS

2.1 HYDRANTS

A. Use existing hydrant unless contracted to provide a new unit.

2.2 WATER SERVICE METERS

A. Use existing water meter and yoke unless contracted to provide a new unit.

2.3 CONCRETE

A. Class 3000 or 4000 cast-in-place, Section 03 30 04.

PART 3 EXECUTION

3.1 PREPARATION

A. Before commencing work, coordinate location and shutdown of utility lines with utility company and residents, Section 01 31 13.

B. Protect existing hydrants and meters from damage.

C. Control ground water, surface water, storm water.

D. Control pedesrian and vehicular traffic, Section 01 55 26.

E. Provide all excavation backfill, compaction, connections, testing, and surface restorations to made the installation complete.

3.2 MOVE EXISTING HYDRANT

A. APWA Plan 546. Relocate to location indicated.

B. Do not disturb location of hydrant lateral tee at water main.

C. The method of harnessing the hydrant (reshackling or reblocking) shall match existing conditions or approval of ENGINEER.

D. Install hydrant so base flange is even with or less than four (4) inches above grade of surrounding surface.

E. Use same type of pipe material as used for existing hydrant piping unless indicated otherwise.

F. Use mechanical and flange joint fittings unless required otherwise. Use only new tees, fittings, and bends.

G. Coat all weld connections and damaged areas of metal piping with coal tar enamel. Follow AWWA C203 requirements. Tape wrap coatings.

3.3 RECONNECT EXISTING HYDRANT

A. Hydrant reconnection shall meet new work requirements indicated in Section 33 12 19.

B. When existing tee on water main is to be moved to new location, seal and shackle old tee.

3.4 HYDRANT BARREL EXTENSION

A. Follow AWWA C502 to extend barrel, operating stem and flanged adapters in design material and workmanship so hydrant base flange is even with or less than four (4) inches above grade of surrounding surface.

3.5 MOVE WATER METER AND BOX

A. Verify with water company for use of Type K copper pipe (Section 33 05 03) or polyethylene pipe (Section 33 05 06) from main to meter yoke.

B. Follow installation procedure in Section 33 12 33. In paved surfaces, follow procedure in Section 33 05 14 when adjusting structures to grade.

3.6 FIELD QUALITY CONTROL

A. Hydrostatic tests, Section 33 08 00.

B. Disinfection, Section 33 13 00.

END OF SECTION

SECTION 33 12 16
WATER VALVES

PART 1 GENERAL

1.1. SECTION INCLUDES

A. Gate, butterfly, plug, check, pressure reducing, pressure relief, control valves and their installation.

1.2 REFERENCES

A. **AWWA Standards**:

C111	Rubber-Gasket Joints for Ductile-Iron and Gray-Iron Pressure Pipe and Fittings.
C504	Rubber-Seated Butterfly Valves.
C508	Swing-Check Valves for Waterworks Service, 2 In. Through 24 In. NPS.
C509	Resilient-Seated Gate Valves for Water and Sewerage Systems.
C550	Protective Interior Coatings for Valves and Hydrants.
C600	Installation of Ductile-Iron Water Mains and Their Appurtenances.

1.3 SUBMITTALS

A. Provide technical information for evaluating quality of valve. As a minimum include dimensions, weights, materials lists and operation charts.

PART 2 PRODUCTS

2.1 VALVES - GENERAL

A. Underground:

1. Less than three (3) inches: Screwed ends.
2. 3 inches and larger: Flanged or mechanical joint ends. Non-rising stem. Two inches square operating nut. Low alloy steel bolts, AWWA C111.

B. Submerged or Above Sewage or Water:

1. Valve body bolts per manufacturer's recommendations.
2. For joining valve to piping system use stainless steel nuts and bolts, Section 05 05 23.

C. Below an Operating Deck: Provide shaft extension from the valve to deck level.

D. Above Ground: Non-rising stems equipped with a hand wheel.

E. Manually Operated Valves Over six (6) feet Above Operating Level: Provide chain operated handles.

F. Clearance: Install so handles clear all obstruction when moved from open to closed.

G. Rated Working Pressure: 150 psi if not indicated.

H. Coating: Interior, AWWA C550. Exterior per manufacturer's recommendation.

2.2 **GATE VALVES**

A. AWWA C509.

B. 3 inches through 48 inches, cast iron body, bronze mounted, non-rising stem with "O" ring seals.

C. Open counterclockwise.

2.3 **BUTTERFLY VALVES**

A. AWWA C504.

B. 3 inches through 48 inches, cast iron body, bronze mounted.

C. Short body if disc will not interfere with adjacent fittings or long body at CONTRACTOR's option.

D. Wafer Valves: Subject to ENGINEER's approval.

2.4 **ECCENTRIC PLUG VALVES**

A. Material: Cast iron body, bronze mounted, non-lubricated, eccentric, quarter-turn type with resilient face plugs, ductile iron discs with upper and lower shafts integral.

B. Markings: Indicate open and close position.

C. Port Areas: At least 82 percent of full pipe area.

D. Resilient Seat Seals: Buna N, field replaceable.

2.5 **CHECK VALVES**

A. AWWA C508.

B. Less than three (3) inches: Y-pattern, bronze, regrinding, swing check valve, 200 psi working pressure.

C. 3 inches and larger: Iron body, bronze mounted, swing valves with stainless steel hinge pins and outside weight and lever if not indicated otherwise.

2.6 **PRESSURE REDUCING VALVES - SERVICE LINE**

A. Operation: Capable of reducing a varying higher upstream pressure to an adjustable constant lower downstream pressure.

B. Spring and nylon reinforced diaphragm type construction.

C. Equip with Y-strainer upstream of valve.

2.7 **PRESSURE REDUCING VALVES - MAIN LINE**

A. Operation: Capable of maintaining an adjustable constant downstream pressure regardless of upstream pressure.

B. Type: Hydraulically operated using a direct-acting, spring-loaded, normally open, pilot valve controlled diaphragm:
   1. Single removable seat and a resilient disc. No "O" ring type discs permitted. No external packing glands permitted. No pistons operating main valve or pilot controls permitted.
   2. Y-strainers on pilot controls, variable closing and opening speed controls and a valve position indicator.

C. Rating: 250 psi working pressure.

D. Connection: Flanged.

E. Pressure Gage: Upstream and downstream of valve capable of accurately measuring system pressures.

2.8 PRESSURE RELIEF VALVES

A. Operation: Maintain a constant upstream pressure by passing or relieving excess pressure.

B. Closed Valves: Drip-tight.

C. Type: Hydraulically operated, pilot control using a diaphragm with a single removable seat and resilient disc.

D. Pilot Controls: Direct acting, adjustable between 20 and 200 psi, spring-loaded diaphragm valve.

E. Rating: 250 psi working pressure.

F. Connection: Flanged.

2.9 CONTROL VALVE

A. Globe: Diaphragm actuated, single seated, composition disc, hydraulically operated.

B. Pilot Controls: Externally mounted, four-way, solenoid pilot valve with self cleaning strainers and diaphragm type check valves:
   1. Equipped with a limit switch for pump control.
   2. Equipped with a built-in lift check valve to prevent flow reversal.

E. Rating: 250 psi working pressure.

F. Connection: Flanged.

G. Solenoids and Limit Switch: Supplied with operating voltage indicated.

PART 3 EXECUTION

3.1 INSTALLATION

A. Flush all lines before valve installation.

B. In ductile iron water mains, AWWA C600.

C. Install butterfly valve shafts vertical in vault boxes and horizontal otherwise.

SECTION 33 12 19
HYDRANTS

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Dry-barrel fire hydrants, valves, piping and accessories.

1.2 REFERENCES

A. **APWA (Utah) Standards**:

Plan 511 Fire hydrant with valve.

Plan 561 Direct bearing thrust block.

Plan 562 Tie-down thrust restraints.

B. **AWWA Standards**:

C110 Ductile-Iron and Gray-Iron Fittings, 3 In. Through 48 In., for Water and Other Liquids.

C111 Rubber-Gasket Joints for Ductile-Iron and Gray-Iron Pressure Pipe and Fittings.

C209 Cold-Applied Tape Coatings for the Exterior of Special Section, Connections, and Fittings for Steel Water Pipelines.

C210 Liquid Epoxy Coating Systems for the Interior and Exterior of Steel Water Pipelines.

C213 Fusion-Bonded Epoxy Coating for the Interior and Exterior of Steel water Pipelines.

C214 Tape Coating Systems for the Exterior of Steel Water Pipelines.

C502 Dry-Barrel Fire Hydrants.

M17 Manual for Installation, Operation, and Maintenance of Fire Hydrants.

1.3 PRODUCT HANDLING

A. Package fire hydrants, gate valves, and valve boxes for protection against dirt and damage during shipment and storage.

B. Do not plug drain hole.

1.4 SUBMITTALS

A. Product Data: Manufacturer's technical product data and installation instructions.

B. Shop Drawings: Show interface and spatial relationship between piping and adjacent structures.

C. Field Quality Control Reports: For system commissioning, Section 33 08 00.

1.5 **JOB CONDITIONS**

A. Notify appropriate fire department as soon as hydrant is removed or placed in service.

PART 2 PRODUCTS

2.1 **DRY-BARREL FIRE HYDRANT**

A. AWWA C502.

B. Cast iron compression type, opening against pressure and closing with pressure, base valve design, 150 psi working pressure, with 1/4 inch diameter minimum tapping and bronze plug in standpipe:

1. Size: 5-1/4 inch valve opening.
2. Direction to Open Hydrant: Counterclockwise.
3. Size and Shape of Operating and Cap Nuts: Pentagon. 1-1/2 inch point to flat.
4. Hose Nozzles: Two 2-1/2 inch national standard thread, cap, gasket and chain.
5. Pumper Nozzle: One 4-1/2 inch national standard thread, cap, gasket and chain.
6. Depth of Burial: 48 inches or consistent with main depth.
7. Connection to Main: Six (6) inches flanges or mechanical joint.
8. Pressure: 150 psi working pressure and 300 psi hydrostatic pressure.
9. Inlet Bottom Connection: Six (6) inches mechanical joint or flanged in accordance with AWWA C110 and AWWA C111, designed to allow separation at the sidewalk or ground level when hydrant is sheared off.
10. Automatic Drain: Opens as the hydrant is closed.

2.2 **PIPE AND FITTINGS**

A. Ductile Iron: Section 33 05 05. Standard drilling with joints per AWWA C110.

B. PVC: Section 33 05 07.

C. Steel: Section 33 05 09. Standard drilling, 150 lb.

D. Spool: Schedule 40 steel, epoxy lined, exterior wrapped with minimum six (6) mil thick polyethylene sheet and tape wrap, AWWA C210 or C213 and C209 or C214 with two welded in place 150 lb. steel ANSI B 16.5 slip on flanges.

2.3 **VALVES**

A. Gate Valve: Section 33 12 19.

B. If indicated, furnish an auxiliary six (6) inch diameter valve with end connections as required.

2.4 ACCESSORIES

A. Bolts, Nuts, Washers: Stainless steel, Section 05 05 23.

B. Anchorages: Provide anchorages for tees, wyes, crosses, plugs, caps, bends, valves, and hydrants. After installation, apply full coat of asphalt or other acceptable corrosion-retarding material to surfaces of ferrous anchorages.

C. Thrust Blocks: Concrete Class 2000 minimum cast-in-place, Section 03 30 04.

D. Valve Box, Valve Chamber: Section 33 12 19.

PART 3 EXECUTION

3.1 PREPARATION

A. Excavation, Section 31 23 16.

3.2 INSTALLATION

A. Install hydrant according to APWA Plan 511 and AWWA M17.

B. Install hydrants, valves, and valve boxes as indicated and located. Hydrants shall not be connected to or located within 10 feet of a sanitary sewer or storm drain.

C. Install so bottom of hydrant base flange is above grade four (4) inches plus or minus two (2) inches.

D. Point 4-1/2 inch pumper nozzle to face the street.

E. Drain holes at base of hydrant to remain clear with a minimum of 1 cubic yard of clean sewer rock (Section 32 11 23) placed around hydrant base and drain. Place sheet plastic over gravel to prevent silting.

F. Coal tar and tape wrap steel pipe.

G. Grease all buried nuts, bolts, and steel ancillaries then wrap with six (6) mil thick polyethylene sheet and tape wrap.

H. Install thrust blocks according to APWA Plan 561 or 562.

3.3 BACKFILLING

A. Secure water company permission to commence backfilling operation.

B. Trenches, Section 33 05 20.

C. Structures, Section 31 23 23.

D. Landscaping, Section 32 91 19.

E. Pavements, Section 32 05 10.

3.4 PAINT

A. Paint buried portion of hydrant with two coats of coal tar enamel or asphalt.

B. Paint hydrant barrel and caps with one coat primer and final coat per water company paint standards.

3.5 FIELD QUALITY CONTROL

A. Commisioning, Section 33 08 00.

B. Disinfection, Section 33 13 00.

END OF SECTION

SECTION 33 12 33
WATER METER

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Water meters, service connections, materials.

1.2 REFERENCES

A. **AWWA Standards**:

C704 Cold-Water Meters - Propeller Type for Main Line Applications.

C800 Underground Service Line Valves and Fittings.

1.3 SUBMITTALS

A. Manufacturer's test records for range and accuracy of meter being furnished.

B. Equipment material diagram and parts schematic.

PART 2 PRODUCTS

2.1 METERS FOR SYSTEM PIPING

A. Materials and Construction: AWWA C704:

1. Cast iron bodies, 175 psi working pressure, flanged connections.
2. Built-in straightening vanes.
3. Working pressure 150 psi.
4. Polyethylene plastic propeller.
5. Stainless steel shaft with stainless steel ball bearings, lubricated by means of a single pressure fitting.

B. Accuracy: Plus or minus two (2) percent of scale for velocities over 1 foot per second.

C. Totalizer: Six digits reading in units required.

2.2 METERS FOR SERVICE PIPING

A. Provided by OWNER unless indicated otherwise.

2.3 SERVICE LINE, VALVES, AND FITTINGS

A. Service Pipe: Copper, Section 33 05 03 or smooth wall polyethylene, Section 33 05 06. The service pipe between main and meter and to a point not less than 1 foot from the public way side of the property line cannot exceed the meter size.

B. Service Valves and Fittings: AWWA C800.

C. Meter Setters: Brass, with angle fittings, saddle nuts and gaskets.

D. Corporation Stops and Angle Valves: Invert key design.

E. Bypasses: Not allowed on any service installation without approval of ENGINEER.

2.4 METER BOXES

A. Meters to 1" Service: Plastic or asphalt-dipped corrugated metal. Fiber meter boxes not acceptable.

B. Meters 1-1/2" and Larger: Reinforced concrete with a minimum clearance of 12" from each side of meter plumbing.

C. Cover: Ductile or cast iron with utility inscription

PART 3 EXECUTION

3.1 INSTALLATION

A. Install meter box, meter setters, valves, etc. at indicated locations. If not indicated, install in street right-of-way parking strip or at a location approved by ENGINEER.

B. Install meter setters level and horizontal. Provide suitable pipe lengths to prevent stress.

C. DO NOT operate utility agency's main line valves. Contact agency if valves are to be operated. If required by water utility agency notify affected water users, Section 01 31 13.

D. OWNER Supplied Meters: Installed by CONTRACTOR unless indicated otherwise.

END OF SECTION

SECTION 33 13 00
DISINFECTION

PART 1 GENERAL

1.1 **SECTION INCLUDES**

A. Disinfection of potable water system.

B. Test and report results.

1.2 **REFERENCES**

A. **AWWA Standards**:

A100 Water Wells.

B300 Hypochlorites.

B301 Liquid Chlorine.

C651 Disinfecting Water Mains.

C652 Disinfection of Water-Storage Facilities.

B. **State of Utah Standards**:

Public Drinking Water Regulations, Part 2, Section 12.

1.3 **DEFINITIONS**

A. **Disinfectant Residual**: The quantity of disinfectant in treated water.

B. **ppm**: Parts per million.

1.4 **SUBMITTALS**

A. CONTRACTOR's evidence of experience in disinfection.

B. Bacteriological laboratory's certification.

C. Disinfection Report: Three (3) copies containing:

1. Date issued.
2. Project name and location.
3. Treatment contractor's name, address and phone number.
4. Type and form of disinfectant used.
5. Time and date of disinfectant injection started.
6. Time and date of disinfectant injection completed.
7. Test locations.
8. Initial and follow-up disinfectant residuals in ppm for each outlet tested.
9. Time and date of flushing start.
10. Time and date of flushing completion.
11. Disinfectant residual after flushing in ppm for each outlet tested.
12. Flush water disposal location and acceptance by local agency.

D. Bacteriological Report: Three (3) copies including:
   1. Date issued.
   2. Project name and location.
   3. Laboratory's name, certification number, address, and phone number.
   4. Time and date of water sample collection.
   5. Name of person collecting samples.
   6. Test locations.
   7. Time and date of laboratory test start.
   8. Coliform bacteria test results for each outlet tested.
   9. Certification that water conforms or fails to conform to bacterial standards of State of Utah public drinking water regulations.
   10. Bacteriologist's signature.

1.5 **QUALITY ASSURANCE**

A. Bacteriological Laboratory: Certified by State of Utah if laboratory is other than OWNER's laboratory.

1.6 **PRODUCT HANDLING**

A. Store and protect disinfectant in accordance with manufacturer's recommendations to protect against damage or contamination. Do not use unsuitable disinfectant.

B. Follow all instruction labeling for safe handling and storage of disinfectant materials.

1.7 **REGULATORY REQUIREMENTS**

A. Conform to State of Utah public drinking water regulations.

PART 2 PRODUCTS

2.1 **DISINFECTANT**

A. AWWA B301. Liquid chlorine 99.5 percent pure by volume.

B. AWWA B300. Sodium hypochlorite not less than 100 grams per liter available chlorine.

C. AWWA B300. Calcium hypochlorite 65 to 70 percent available chlorine by weight in granular form.

D. Powder, tablet, or gas according to manufacturer's specification.

2.2 **ALKALI**

A. Caustic soda or soda ash.

2.3 **ACID**

A. Hydrochloric (muriatic).

PART 3 EXECUTION

3.1 PREPARATION

A. Provide necessary signs, barricades, and notices to prevent accidental exposure to disinfecting materials, consuming disinfecting water, or disturbing system being disinfected.

B. Make sure potable water system is complete, clean, and that the system to be disinfected is not connected to an existing system.

3.2 DISINFECTION OF WATER LINES

A. Use one method defined under AWWA C651 that is acceptable to ENGINEER.

B. After pressure testing per Section 33 08 00, flush system through hydrants or if a hydrant does not exist, install a tap of sufficient size to provide 2.5 feet per second flushing velocity in the line.

C. Starting at outlet closest to water source, bleed water from each outlet until chlorine residual reaches outlet. Repeat process at each outlet throughout system.

D. Collect a bacteriological water sample at end of line to be tested. If sample fails bacteriological test, flush system and retest. Continue flushing and retesting until a good sample is obtained.

E. If flushing does not produce a passing bacteriological test disperse disinfectant throughout system to obtain 10 to 25 ppm of free chlorine residual.

F. Flush the chlorinated water from the main until chlorine measurements show concentration in the water leaving the main is no higher than that generally prevailing in the system or is acceptable for domestic use.

G. After a passing bacteriological test sample is obtained, let the system relax for 24 hours. Flush and collect a subsequent bacteriological sample for testing. If the subsequent test passes then water line is acceptable.

3.3 DISINFECTION OF CULINARY WELLS

A. Use one method defined under AWWA A100 that is acceptable to ENGINEER.

B. Do not start disinfection until well is thoroughly cleaned.

C. Use a disinfecting solution containing a minimum of 50 ppm residual chlorine.

D. Flush system after disinfection.

3.4 DISINFECTION OF WATER STORAGE RESERVOIRS

A. Use one method defined under AWWA C652 that is acceptable to ENGINEER.

B. Do not start disinfection until water storage tank is thoroughly cleaned.

C. Provide and use necessary safety equipment for workers in contact with disinfectant or gasses.

D. Flush system after disinfection.

3.5 FIELD QUALITY CONTROL

A. Bacteriological Test:

1. Collect samples for testing no sooner than 16 hours after system flushing.
2. Analyze water samples per State of Utah requirements.
3. If bacteriological test proves water quality to be unacceptable, repeat system treatment.
4. Do not place water systems into service until a passing bacteriological test is made. Provide a copy of the passing test to ENGINEER.

B. Disposal of Disinfectant:

1. Legally dispose of disinfecting water and ensure no chlorine buildup or damage to the environment.

END OF SECTION

SECTION 33 31 00
SANITARY SEWERAGE SYSTEMS

PART 1 GENERAL

1.1 **SECTION INCLUDES**

A. Installation of a buried non-pressure sanitary sewer pipe system.

B. Refer to Section 33 11 00 if installation is a pressurized pipe system.

1.2 **REFERENCES**

A **APWA (Utah) Standards**:

Plan 255 Bituminous concrete T-patch

Plan 256 Concrete pavement patch

Plan 381 Trench backfill

Plan 382 Pipe zone backfill

Plan 411 Sanitary sewer manhole

Plan 431 Sewer lateral connection

B. **ASTM Standards**:

C478 Precast Reinforced Concrete Manhole Section.

C891 Installation of Underground Precast Concrete Utility Structures.

C923 Resilient Connectors Between Reinforced Concrete Manhole Structures, Pipes and Laterals.

1.3 **DEFINITIONS**

A. **Non-pressure Pipe System**: Defined in Section 33 41 00.

1.4 **PERFORMANCE REQUIREMENTS**

A. Vertical Cover: Unless indicated otherwise, provide at least two (2) feet of protection cover during construction.

B. Remove any section of pipe already placed that is found to be out of alignment tolerance, defective, or damaged. Relay or replace at no additional cost to OWNER.

1.5 **SUBMITTALS**

A. Product data: Submit manufacturer's technical product data and installation instructions.

B. Commissioning: Provide Section 33 08 00 submittals.

1.6 **SITE CONDITIONS**

A. Minimize neighborhood traffic interruptions. Barricade stockpiles.

B. Provide access to adjacent properties for local traffic and pedestrians, Section 01 31 13.

1.7 **ACCEPTANCE**

A. Each samitary sewer system component must pass aapplicable commissioning requirements in Section 33 08 00.

PART 2 PRODUCTS

2.1 **PIPES AND FITTINGS**

A. Provide piping materials and factory fabricated piping products of sizes, types, and classes required.

B. Where not indicated, select product acceptable to ENGINEER and comply with installation requirements.

C. Provide pipe fittings and accessories of same material and weight or class as pipe, with joining method indicated or recommended by manufacturer.

2.2 **MORTAR, GROUT AND CONCRETE**

A. Portland cement mortar, Section 04 05 16.

B. Non-shrink grout, Section 03 61 00.

C. Concrete:

1. Cast-in-place: Section 03 30 04.
2. Precast Concrete: Section 03 40 00.

2.3 **MANHOLES**

A. Basin: Concrete floor and walls, or ASTM C478 precast concrete.

B. Steps: None.

C. Top: Concentric cone. Concentric flat slab concrete deck allowed only with ENGINEER's permission.

D. Frame and Cover: Scoriated, asphalt coated, heavy duty, ductile iron Section 05 56 00, with flat top design meeting load rating H-20 and appropriate utility lettering. Shape, size and lifting device as necessary.

E. Pipe Connectors:

1. Precast Bases: Resilient, ASTM C923. Sand mortar grout pipe connections.
2. Cast in Place or Connections to Existing Fixture with Plastic Pipe: Use rubber adapter gasket for precast sections. Grout, Section 03 61 00 for cast in place sections.

F. Joints in Sections: Bituminous mastic gasket-type sealant or otherwise acceptable to ENGINEER.

PART 3 EXECUTION

3.1 PREPARATION

A. Verify Trench Excavation is ready to receive work, and dimensions, and elevations are correct. Commencing installation means acceptance of existing conditions.

B. Hand trim excavations to required elevations. Backfill over excavations and compact, Section 31 23 26.

C. Examine areas and conditions under which materials and products are to be installed. Do not proceed with system installation until unsatisfactory conditions have been corrected in manner acceptable to system installer.

D. Clearly identify and promptly set aside defective or damaged pipe.

E. Use pipe cutting tool acceptable to pipe manufacturer.

3.2 ABANDONED UTILITIES

A. Use concrete to plug and cap openings in abandoned underground utilities that are to remain in place.

B. Provide closures to withstand hydrostatic or earth pressure that may result after abandoned utilities have been closed.

3.3 INSTALLATION - PIPE AND FITTINGS

A. Install pipe and fittings per APWA Plan 382.

B. Place bell or groove end facing upstream.

C. Install gaskets per manufacturer's recommendations.

D. Plug pipeline branches, stubs or other open ends that are not to be immediately connected.

E. Clean interior of pipe of dirt and debris as work progresses.

F. Meet line and grade tolerance in Section 33 08 00. Use a laser device or demonstrate an equivalent method of establishing line and grade.

3.4 INSTALLATION - JOINTS

A. Join pipe per manufacturer's recommendation.

B. Join pipe of different sizes at manholes only.

C. Use neoprene couplings with stainless steel bands to make connections between dissimilar pipe, or where standard pipeline joints are impractical.

3.5 INSTALLATION - MANHOLES

A. Install manholes per APWA Plan 411.

B. Form bottom of excavation clean and smooth to correct elevation.

C. Place structures in location indicated.

D. Provide elevations and pipe inverts for inlets and outlets indicated.

E. When structures occur in Pavements, mount frame and cover 1/2 inch below finished surface. Provide a concrete Cover Collar between the frame and bituminous Pavement. Elsewhere set frame and cover three (3) inches above finished grade.

3.6 INSTALLATION - TAP CONNECTIONS-6 INCHES AND SMALLER

A. Install connections per APWA Plan 431.

B. Field cutting into new or existing piping will not be permitted unless written permission is obtained from ENGINEER.

C. Make connections to existing pipe and underground structures, so connections will conform as nearly as practicable to requirements specified for new work.

D. Use commercially manufactured wyes for branch connections. Spring wyes into existing line and encase entire wye, plus six (6) inches overlap, with not less than six (6) inches of concrete.

E. For taps into existing 24 inches or larger piping, or to underground structures, cut opening into unit sufficiently large to allow three (3) inches of concrete to be packed around entering connection. Cut ends of connection passing through pipe or structure wall to conform to shape of and parallel with inside wall, unless otherwise indicated. Grout connection to provide smooth transition inlet into pipe.

3.7 INSTALLATION - TAP CONNECTIONS-LARGER THAN 6 INCHES

A. Not allowed. Provide a Manhole structure per APWA Plan 411.

3.8 BACKFILLING

A. Trench Backfill: Place backfill per Section 33 05 20. Provide product and placement indicated in the following Standard Plans.

1. APWA Plan 382 for pipe zone backfill.
2. APWA Plan 381 for trench backfill above pipe zone.

B. Landscape and Structural Backfill: Place backfill per Section 31 23 23. Provide product and placement indicated.

C. Repair public and private facilities damaged by CONTRACTOR.

3.9 SURFACE FINISHING

A. Roadway Trenches and Patches: Restore pavement patches per Section 33 05 25. Provide product and placement indicated in the following standard plans.

1. APWA Plan 255 for bituminous pavement T-patch.
2. APWA Plan 256 for Portland cement concrete pavement patch.

B. Landscapes: Restore landscaping as indicated and as follows where applicable.

1. Section 32 92 00 for turf and grass cover.

2. Section 32 93 13 for other ground cover.

C. Repair public and private facilities damaged by CONTRACTOR.

3.10 COMMISSIONING

A. Before surface finishing, commission pipeline per Section 33 08 00. Provide sizes and types of equipment connections and fittings that match pipe materials when pressure testing system.

B. If paved surfaces must be kept open prior to commissioning, provide temporary paved surfaces.

3.11 CLEANING

A. Remove debris, concrete, or other extraneous material that accumulates in existing pipes or structures.

B. Clean all pipelines after testing. Do not flush sand, gravel, concrete, debris or other materials into existing piping systems.

END OF SECTION

SECTION 33 41 00
DRAINAGE SYSTEMS

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Installation of a buried non-pressure pipe system such as a storm drain, a sub-drain, irrigation, etc.

B. Refer to Section 33 11 00 if the installation is a pressurized pipe system.

1.2 REFERENCES

A **APWA (Utah) Standards**:

Plan 255	Bituminous concrete T-patch
Plan 256	Concrete pavement patch
Plan 315	Catch basin (single or double grate)
Plan 317	Curb face inlet box
Plan 322	Curb face outlet box
Plan 323	Pipe outfall
Plan 331	Cleanout box
Plan 341	Precast manhole
Plan 381	Trench backfill
Plan 382	Pipe zone backfill

B. **ASTM Standards**:

C 478	Precast Reinforced Concrete Manhole Section.
C 923	Resilient Connectors Between Reinforced Concrete Manhole Structures, Pipes and Laterals.

1.3 DEFINITIONS

A. **Non-pressure Pipe System**: Pipelines with joints that have no leakage after a sustained hydraulic pressure not exceeding 10.8 psi (22 in. Hg) for 10 minutes or a sustained vacuum pressure not exceeding 3 kPa (5 in. Hg) for 10-minutes.

1.4 PERFORMANCE REQUIREMENTS

A. Vertical Cover: Unless indicated otherwise, provide at least two (2) feet of protection cover during construction.

B. Remove any section of pipe already placed that is found to be out of alignment tolerance, defective, or damaged. Relay or replace without additional cost to OWNER.

1.5 **SUBMITTALS**

A. Product data: Submit manufacturer's technical product data and installation instructions.

B. Commissioning: Provide Section 33 08 00 submittals.

1.6 **SITE CONDITIONS**

A. Minimize neighborhood traffic interruptions. Barricade stockpiles.

B. Provide access to adjacent properties for local traffic and pedestrians, Section 01 31 13.

1.7 **ACCEPTANCE**

A. Each drainage system component must pass applicable commissioning requirements in Section 33 08 00.

PART 2 PRODUCTS

2.1 **PIPES AND FITTINGS**

A. Provide piping materials and factory fabricated piping products of sizes, types, and classes required.

B. Where not indicated, select product acceptable to ENGINEER and comply with installation requirements.

C. Provide pipe fittings and accessories of same material and weight or class as pipe, with joining method indicated or recommended by manufacturer.

2.2 **IN-PLANE WALL DRAINAGE**

A. Drainage Core: Manufacturer's standard three-dimensional non-bio-degradable, plastic designed to effectively conduct water to foundation drainage system.

B. Filter Fabric: Manufacturer's standard non-woven geotextile fabric of polypropylene or polyester fibers, or combination.

2.3 **SUB DRAIN FILL MATERIALS**

A. Sewer rock, Section 32 11 23 and geotextile, Section 31 05 19.

2.4 **MORTAR, GROUT AND CONCRETE**

A. Portland cement mortar, Section 04 05 16.

B. Non-shrink grout, Section 03 61 00.

C. Concrete:

1. Cast-in-place: Section 03 30 04.
2. Precast Concrete: Section 03 40 00.

2.5 **MANHOLES**

A. Basin: Concrete floor with cast in place concrete walls or ASTM C478 precast concrete.

B. Steps: None.

C. Top: Concentric cone. Concentric flat slab concrete deck allowed only with ENGINEER's permission.

D. Frame and Cover: Scoriated, asphalt coated, heavy duty, ductile iron Section 05 56 00, with flat top design meeting load rating H-20 and appropriate utility lettering. Shape, size and lifting device as necessary.

E. Pipe Connectors:

1. Precast Bases: Resilient, ASTM C923. Sand mortar grout pipe connections.

2. Cast in Place or Connections to Existing Fixture with Plastic Pipe: Use rubber adapter gasket for precast sections. Grout, Section 03 61 00 for cast in place sections.

F. Joints in Sections: Bituminous mastic gasket-type sealant or otherwise acceptable to ENGINEER.

2.6 INLETS, CATCH BASINS, CLEANOUTS

A. Basin: Concrete floor and walls.

B. Pipe Connectors: Resilient, ASTM C923. Sand mortar grout.

C. Frame and Grate:

1. Asphalt coated, heavy duty, cast iron, Section 05 56 00. Shape and size indicated.

2. Galvanized, heavy duty, steel: Sections 05 12 00 and 05 05 10. Shape and size as indicated.

2.7 OUTFALLS

A. Cast-in-place or precast concrete with reinforced headwall, apron, and tapered sides. Provide riprap, Section 31 37 00, if indicated.

2.8 DRAIN PIPE JOINT SCREENS

A. Heavy mesh burlap, coal-tar saturated felt, 18 to 14 mesh copper screening or synthetic drainage fabric.

B. Plastic or corrosion resistant metal bands.

PART 3 EXECUTION

3.1 PREPARATION

A. Verify Trench Excavation is ready to receive work, and dimensions, and elevations are correct. Commencing installation means acceptance of existing conditions.

B. Hand trim excavations to required elevations. Backfill over excavations and compact, Section 31 23 26.

C. Remove stones larger than two (2) inches or other hard matter that could damage pipe or impede backfilling or compaction.

D. Examine areas and conditions under which materials and products are to be installed. Do not proceed with system installation until unsatisfactory conditions have been corrected in manner acceptable to system installer.

E. Clearly identify and promptly set aside defective or damaged pipe.

F. Use pipe cutting tool acceptable to pipe manufacturer.

3.2 ABANDONED UTILITIES

A. Use concrete to plug and cap open ends of abandoned underground utilities that are to remain in place.

B. Provide closures to withstand hydrostatic or earth pressure that may result after ends of abandoned utilities have been closed.

3.3 INSTALLATION - PIPE AND FITTINGS

A. Place bell or groove end facing upstream.

B. Install gaskets per manufacturer's recommendations.

C. Plug pipeline branches, stubs or other open ends that are not to be immediately connected.

D. Clean interior of pipe of dirt and debris as work progresses.

E. Insulate dissimilar metals from direct contact with each other using neoprene gaskets or asphalt coatings.

F. Meet line and grade tolerance in Section 33 08 00. Use a laser device or demonstrate an equivalent method of establishing line and grade

3.4 INSTALLATION - JOINTS

A. Join pipe per manufacturer's recommendation.

B. Join pipe of different sizes at manholes or cleanouts only.

C. Use neoprene couplings with stainless steel bands to make connections between dissimilar pipe, or where standard pipeline joints are impractical.

3.5 INSTALLATION - MANHOLES

A. Install manholes per APWA Plan 341.

B. Form bottom of excavation clean and smooth to correct elevation.

C. Place structures in location indicated.

D. Provide elevations and pipe inverts for inlets and outlets indicated.

E. When structures occur in Pavements, mount frame and cover 1/2 inch below finished surface. Provide a concrete Cover Collar between the frame and bituminous concrete pavement. Elsewhere set frame and cover three (3) inches above finished grade.

3.6 INSTALLATION - INLETS, CATCH BASINS, CLEANOUTS

A. Install facilities per APWA Plans 315, 316, 317, 331.

B. Form bottom of excavation clean and smooth to correct elevation.

C. Construct with all connecting piping and appurtenances in their final position.

D. Cut all piping parallel to interior surface wall. Grout connection to provide smooth transition inlet into pipe.

3.7 **INSTALLATION SUB DRAIN SYSTEMS**

A. Install pipe and fittings per manufacturer's requirements.

B. Open Joint Systems: Loosely butt pipe ends. Place 12 inches wide filter fabric around pipe circumference, centered over joint.

C. Mechanical Joint Perforated Pipe System: Place pipe with perforations facing down.

D. Place drainage pipe on bed of sewer rock, Section 31 05 13.

3.8 **INSTALLATION - TAP CONNECTIONS**

A. Not allowed in storm drain systems. Provide a cleanout or manhole structure.

3.9 **INSTALLATION - OUTFALLS**

A. Install outfalls per APWA Plans 322 and 323.

3.10 **INSTALLATION - AREA DRAINS**

A. Install area drains per APWA Plan 372.

3.11 **BACKFILLING**

A. Trench Backfill: Place backfill per Section 33 05 20. Provide product and placement indicated in the following Standard Plans.

1. APWA Plan 382 for pipe zone backfill.
2. APWA Plan 381 for trench backfill above pipe zone.

B. Landscapes: Restore landscaping as indicated and as follows where applicable.

1. Section 32 92 00 for turf and grass cover.
2. Section 32 93 13 for other ground cover.

C. Repair public and private facilities damaged by CONTRACTOR.

3.12 **SURFACE FINISHING**

A. Roadway Trenches and Patches: Restore pavement patches per Section 33 05 25. Provide product and placement indicated in the following standard plans.

1. APWA Plan 255 for bituminous pavement T-patch.
2. APWA Plan 256 for concrete pavement patch.

B. Landscapes: Restore landscaping as indicated and as follows where applicable.

1. Section 32 92 00 for turf and grass cover.
2. Section 32 93 13 for other ground cover.

C. Repair public and private facilities damaged by CONTRACTOR.

3.13 COMMISSIONING

A. Before surface finishing, commission pipeline per Section 33 08 00. Provide sizes and types of equipment connections and fittings that match pipe materials when pressure testing system.

B. If paved surfaces must be kept open prior to commissioning, provide temporary paved surfaces.

3.14 CLEANING

A. Remove debris, concrete, or other extraneous material that accumulates in existing piping or structures.

B. Clean all pipelines after testing. Do not flush sand, gravel, concrete, debris or other materials into existing piping systems.

END OF SECTION

SECTION 33 47 00
PONDS

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Clearing pond site and disposal of debris and unsuitable material.

B. Materials for dikes.

1.2 REFERENCES

A. **ASTM Standards**:

D3282 Classification of Soils and Soil-Aggregate Mixtures for Highway Construction Purposes.

1.3 SUBMITTALS

A. Laboratory analysis and control testing reports of fill to be used in dikes.

B. Sample of geosynthetics to be installed.

C. Quality assurance test results within 24 hours of completed test results.

1.4 PERFORMANCE

A. Protection: Do not contaminate embankment materials with debris or unsuitable material. Protect existing improvements, trees, structures or other items from damage during construction.

B. Dust Control: Section 01 57 00. Prevent dust from being a nuisance to neighborhood, and performance of separate work.

1.5 QUALITY ASSURANCE

A. Perform density tests to assure compacted backfills comply.

B. Do not interrupt surface drainage systems at site without ENGINEER's approval.

C. Control erosion during construction and correct any damage caused by runoff.

PART 2 PRODUCTS

2.1 BACKFILL SOILS

A. Authorized over-excavation fill, Section 31 23 16.

B. Common fill, Section 31 05 13.

C. Aggregate base course, Section 32 11 23.

D. Cement treated fill, Section 31 05 15.

E. Impermeable embankment, ASTM D3282. A-4, or A-6 material, with a plasticity index of at least 10, and a coefficient of permeability less than 7×10^{-6} cm/sec.

F. Obtain approval of backfill soils to be supplied before beginning construction.

2.2 GEOSYNTHETIC MATERIALS

A. Impermeable, nonbiodegradable sheet material, inert to soil chemicals, resistant to molds, mildew, acids and alkalis, and within a pH range of 3 to 12.

PART 3 EXECUTION

3.1 CONSTRUCTION

A. Remove and stockpile topsoil material for later placement on outer dike surfaces.

B. Excavation, Section 31 23 16.

C. Level areas where dikes are to be constructed.

D. Scarify subgrade 12 inches and compact to 92 percent minimum relative to a standard proctor density, Section 31 23 26.

E. Place embankment materials in lifts consistent with compaction equipment capability. Compact backfill soils to 95 percent or greater relative to a standard proctor. Do not construct embankment with frozen or unapproved material.

F. Shape dikes to the slopes indicated.

3.2 TOLERANCES

A. Dike Surface: Plus or minus 1 inch from true grade.

B. Dike Width: Plus or minus three (3) inches from design dimension.

C. Dike Alignment: Plus or minus six (6) inches from true line.

3.3 FINISHING

A. After dikes have been constructed to lines and grades indicated, spread topsoil on dikes and grade to uniform slope and thickness.

B. Dispose of excess or unsuitable materials and smooth grade all affected areas.

C. Leave site free of debris.

END OF SECTION