Logan UT Seminary Building
110 West 100 South
Logan, UT 84321

FFKR Project Number 24003

Construction Documents

August 15, 2024

FFKR ARCHITECTS

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INVITATION TO BID (U.S.)

1. GENERAL CONTRACTORS INVITED TO BID THE PROJECT:

See Bid Invitation and Information Form

2. PROJECT:

Logan UT Seminary Building

3. LOCATION:

110 West 100 South; Logan, Utah 84321

4. OWNER:

The Church of Jesus Christ of Latter-day Saints, a Utah corporation sole
c/o
Utah North Project Management Office
435 North Wall Avenue, Suite D
Ogden, Utah 84404

5. CONSULTANT:

FFKR Architects
730 Pacific Avenue
Salt Lake City, Utah 84104

6. DESCRIPTION OF PROJECT:

A. Demolition of existing building and replacement with new single-story Seminary Building, accommodating three classrooms, office space, breakroom, and other Work indicated in the Contract Documents

B. Products or systems may be provided through relationships the Owner has negotiated with suppliers as indicated in the Specifications.

7. TYPE OF BID: Bids will be on a lump-sum basis. Segregated bids will not be accepted.

8. TIME OF SUBSTANTIAL COMPLETION: The time limit for substantial completion of this work will be 240 calendar days and will be as noted in the Agreement.

9. BID OPENING: Bids will be received by Owners preferred method at (time and date at place) to be announced. Bids will be publicly opened at (time and date at place) to be announced.

10. BIDDING DOCUMENTS:

A. Bidding Documents may be examined at the following plan room locations:

1)

2)

3)

4)

B. Bidding Documents may be obtained from the Architect.

C. Bidding Documents may be obtained from Owner’s electronic bidding tool.

11. BID BOND: If required, bid security in the amount of 5 percent (5%) of the bid will accompany each bid in accordance with the Instruction to Bidders.

12. BIDDER'S QUALIFICATIONS: Bidding by the General Contractors will be by invitation only.

13. OWNER'S RIGHT TO REJECT BIDS: The Owner reserves the right to reject any or all bids and to waive any irregularity therein.

END OF DOCUMENT

INSTRUCTIONS TO BIDDERS (U.S.)

1. DEFINITIONS:

A. The definitions set forth in Section 1 of the General Conditions are applicable to the documents included under Bidding Requirements.

B. Bidding Documents include the Bidding Requirements and the proposed Contract Documents. The proposed Contract Documents consist of the documents identified as Contract Documents in the Form of Agreement, except for Modifications. The Bidding Requirements are those documents identified as such in the proposed Project Manual.

C. Addenda are written, or graphic documents issued by the Architect prior to execution of the Contract which modify or interpret the Bidding Documents. They become part of the Contract Documents as noted in the Form of Agreement upon execution of the Contract.

2. BIDDER'S REPRESENTATIONS:

A. By submitting a bid, the bidder represents that
   1) Bidder has carefully studied and compared the Bidding Documents with each other. Bidder understands the Bidding Documents and the bid is fully in accordance with the requirements of those documents,
   2) Bidder has thoroughly examined the site and any building located thereon, has become familiar with local conditions which might directly or indirectly affect the contract work, and has correlated its personal observations with the requirements of the proposed Contract Documents, and
   3) Bid is based on the materials, equipment, and systems required by the Bidding Documents without exception.

3. BIDDING DOCUMENTS:

A. Copies
   1) Bidding Documents may be obtained as set forth in the Invitation to Bid.
   2) Partial sets of Bidding Documents will not be issued.
   3) Bidders will use complete sets of Bidding Documents in preparing bids and make certain that those submitting sub-bids to them have access to all portions of the documents that pertain to the work covered by sub-bid, including General Conditions, Supplementary Conditions, and Division 01. Bidder assumes full responsibility for errors or misinterpretations resulting from use of partial sets of Bidding Documents by itself or any sub-bidder.

B. Interpretation or Correction of Bidding Documents
   1) Bidders will request interpretation or correction of any apparent errors, discrepancies, and omissions in the Bidding Documents.
   2) Corrections or changes to Bidding Documents will be made by written addenda.

C. Substitutions and Equal Products
   1) Generally speaking, substitutions for specified products and systems, as defined in the Uniform Commercial Code, are not acceptable. However, equal products may be approved upon compliance with Contract Document requirements.
   2) The terms *'Acceptable Manufacturers', 'Approved Manufacturers 'Suppliers', Installers'* and *'VMR (Value Managed Relationship) Manufacturers / Suppliers / Installers'* are used throughout the Project Manual to differentiate among the options available to Contractor regarding specified products, manufacturers, and suppliers. See Section 016000 for options available regarding acceptance of equal products.
   3) Base bid only on materials, equipment, systems, suppliers or performance qualities specified in the Bidding Documents.

4) Architect is only authorized to consider requests for approval of equal products to replace specified products in Sections where the heading '*Acceptable Manufacturers*' is used and statement, *'Equal as approved by Architect before bidding. See Section 016000'* or *'Equal as approved by Architect before installation. See Section 016000,'* appears. In Sections where the afore-mentioned statements do not appear and a different heading is used, Architect is authorized as Owner's representative to decline consideration of requests for approval of equal products. Approvals of equal products in such Sections must be made by Owner and will generally be for subsequent Projects.

D. Addenda - Addenda will be sent to bidders and to locations where Bidding Documents are on file no later than 2 business days prior to bid opening.

4. BIDDING PROCEDURES:

A. Form and Style of Bids
1) Use Owner's online bidding tool.
2) Fill in all blanks on online bidding tool. Signatures will be executed by representative of bidder duly authorized to make contracts.
3) Bids will bear no information other than that requested on bid form. Do not delete from or add to the information requested on the bid form.

B. Bid Security
1) If required, each bid will be accompanied by a bid bond naming Owner, as listed in the Agreement, as obligee. If Bidder refuses to enter into a Contract or fails to provide bonds and insurance required by the General Conditions, amount of bid security will be forfeited to Owner as liquidated damages, not as a penalty.
2) Bid bond will be issued by a surety company meeting requirements of the General Conditions for surety companies providing bonds and will be submitted on AIA Document A310, Bid Bond or AIA authorized equivalent provided by surety company. The attorney-in-fact who executes the bond on behalf of the surety will affix to the bond a certified and current copy of the power of attorney.
3) Owner may retain bid security of bidders to whom an award is being considered until -
a. Contract has been executed and bonds have been furnished,
b. Specified time has elapsed so bids may be withdrawn, or
c. All bids have been rejected.

C. Submission of Bids
1) Follow the instructions in the Owner's bidding tool when submitting your bid.
2) It is bidder's sole responsibility to see that its bid is received at specified time.
3) No oral, facsimile transmitted, telegraphic, or telephonic bids, modifications, or cancellations will be considered.

D. Modification or Withdrawal of Bid
1) Bidder guarantees there will be no revisions or withdrawal of bid amount for 45 days after bid opening.
2) Prior to bid opening, bidders may withdraw bid from Owner's bidding tool.

5. CONSIDERATION OF BIDS:

A. Opening of Bids - See Invitation to Bid.

B. Rejection of Bids - Owner reserves right to reject any or all bids and to waive any irregularity therein.

C. Acceptance of Bid
1) No bidder will consider itself under contract after opening and reading of bids until Agreement between Owner and Contractor is fully executed.
2) Bidder's past performance, organization, subcontractor selection, equipment, and ability to perform and complete its contract in manner and within time specified,

together with amount of bid, will be elements considered in award of contract.

6. POST-BID INFORMATION:

A. The conditionally accepted bidder submitting a bid involving subcontractors will submit its list of proposed subcontractors within 24 hours after bid opening.

7. PERFORMANCE BOND AND PAYMENT BOND:

A. Bond Requirements - Performance Bond and Labor and Material Payment bond may be required for this Project as specified in the General Conditions.

B. Time of Delivery of Bonds - Bonds will be delivered to Owner with Agreement signed by bidder.

8. FORM OF AGREEMENT BETWEEN OWNER AND CONTRACTOR:

A. Agreement form will be “Agreement Between Owner and Contractor for a Fixed Sum (U.S.)”, “General Conditions Fixed Sum (U.S.)” and “Supplementary Conditions Fixed Sum (U.S.)”.

9. MISCELLANEOUS:

A. Pre-Bid Conference
   1) A pre-bid conference will be held at a time and place to be announced.

B. Liquidated Damages - Conditions governing liquidated damages are specified in the General Conditions and in the Supplementary Conditions.

C. Examination Schedule for Existing Building and Site
   1)

D. Exemption from local taxes - See Supplementary Conditions

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INFORMATION AVAILABLE TO BIDDERS (U.S.)

1. GEOTECHNICAL DATA

A. Geotechnical Report -

1) Owner has secured the services of a geotechnical engineer to aid in design of the Project. Following conditions apply -

a) A geotechnical report has been prepared by GSH Geotechnical, referred to as the Geotechnical Engineer.

b) A copy of this report will be issued to each invited Contractor.

c) This report was obtained solely for use in design by Consultant and is not a part of the Contract Documents. It is not intended that Contractor rely on geotechnical engineer's report.

d) Reports are provided for Contractor's information but are not a warranty of subsurface conditions.

2) Prior to bidding, Contractor may make his own subsurface investigations to satisfy himself with site and subsurface conditions.

2. ASBESTOS-CONTAINING MATERIAL (ACM)

A. The building upon which work is being performed has been examined for asbestos-containing material. The following have been identified as containing asbestos in the areas of the building being worked on as part of this Project:

1) Caulking at exterior windows and tar around roof penetrations and at perimeter of roof. These will need to be abated.

B. Refer to Section 02 4116 "Structure Demolition", Article 1.8 - C "Hazarous Materials" for requirements to be followed.

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SUBCONTRACTORS AND MAJOR MATERIALS SUPPLIERS LIST

Project Name: _____ Date:_____

Stake: _____ Project No: _____

General Contractor: _____

General Contractor is to provide the names of the following subcontractors and suppliers to the Owner's Project Manager immediately following the bid opening:

VMR SUBCONTRACTORS

Roofing _____

Doors, Frames & Hardware _____

Storefronts _____

Wood Flooring _____

Other _____

Other _____

SUBCONTRACTORS AND SUPPLIERS

Grading / Site work _____

Site Utilities _____

Demolition _____

Paving _____

Termite Control _____

Site Concrete _____

Fencing _____

Irrigation System _____

Landscaping _____

Building Concrete _____

Masonry _____

Structural Steel _____

Framing _____

Trusses _____

Insulation _____

EIFS _____

Soffit / Fascia _____

Steeple _____

Millwork _____

Drywall _____

Ceramic Tile _____

Acoustical Tile _____

Painting _____

Wall Coverings _____

Elevators / Lifts _____

Draperies _____

Fire Sprinklers _____

Plumbing _____

HVAC _____

Electrical _____

Controls _____

Sound / Satellite _____

EQUAL PRODUCT APPROVAL REQUEST FORM (U.S.)

Project Name: _____ Request Number: _____

TO: _____

FROM: _____

BID DATE: _____

A proposed product is not legally approved and cannot legally be included in a bid or used in the Work until it appears in an Addendum or other Contract Modification as defined in the General Conditions. See Instructions To Bidders Paragraph 3.C, General Conditions, and Section 016000.

PROPOSED EQUAL PRODUCT:

Specification Section: _____

Specified Products: _____

Proposed Product: _____

The Undersigned certifies:

1. Proposed equal product has been fully investigated and determined to be equal or superior in all respects to specified products.
2. Same warranty will be furnished for proposed equal product as for specified products.
3. Same maintenance service and source of replacement parts, as applicable, is available.
4. Proposed equal product will have no adverse effect on other trades and will not affect or delay progress schedule.
5. Proposed equal product does not affect dimensions and functional clearances.

ATTACHMENTS:

Include the following attachments -

1. Copy of the Project Manual Section where the proposed equal product would be specified, rewritten or red-lined to include any changes necessary to correctly specify the proposed equal product. Identify completely changes necessary to the original Project Manual Section.
2. Copies of details, elevations, cross-sections, and other elements of the Project Drawings redone as necessary to show changes necessary to accommodate proposed equal product. Identify completely the changes from the original Drawings.
3. Complete product literature and technical data, installation and maintenance instructions, test results, and other information required to show complete conformance with requirements of the Contract Documents.

SIGNED: _____

Printed Name _____

Company _____

Address _____

City, State, Zip Code _____

Telephone _____ Fax _____

REVIEW COMMENTS:

_____ Accepted. See Addenda Number _____.

_____ Submission not in compliance with instructions. Respond to attached comments and resubmit.

_____ Proposed equal product not acceptable. Use specified products.

_____ Not Reviewed. Submission received too late. Use specified products.

ADDITIONAL COMMENTS:

BY: _____ **DATE:** _____

CONSTRUCTION MATERIAL ASBESTOS STATEMENT (U.S.)

PROJECTS FOR:
THE CHURCH OF JESUS CHRIST OF LATTER-DAY SAINTS,
a Utah corporation sole

Building Name: _____

Building Plan Type: _____

Building Address: _____

Building Owner: The Church of Jesus Christ of Latter-day Saints, a Utah corporation sole.

Project Number: _____

Completion Date: _____

As PROJECT CONSULTANT and principal in charge; based on my best knowledge, information, inspection, and belief; I certify that on the above referenced Project, no asbestos-containing building materials were specified in the construction documents or given approval in shop drawings or submittals.

_____ _____
Project Consultant and Principal in Charge (signature) Date

_____
Company Name

As GENERAL CONTRACTOR in charge of construction; based on my best knowledge, information, inspection, and belief; I affirm that on the above-referenced Project, no asbestos-containing building materials were used in the construction.

_____ _____
General Contractor (signature) Date

_____
Company Name

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AGREEMENT BETWEEN OWNER AND CONTRACTOR
FOR A FIXED SUM (U.S.)

The Church of Jesus Christ of Latter-day Saints, a Utah corporation sole ("Owner") and _____ ("Contractor") hereby enter into this *Agreement Between Owner and Contractor for a Fixed Sum (U.S.)* ("Agreement") and agree as follows:

1. **Property/Project.**

   Property/Project Number:
   Property Address ("Project Site"):
   Project Type:
   Project Name ("Project"):
   Stake Name:

2. **Scope of the Work.** Contractor will furnish all labor, materials, equipment, construction, and services necessary to complete the Work in accordance with the Contract Documents.

3. **Contract Documents.**
   a. The Contract Documents consist of:
      1) This Agreement;
      2) The General Conditions for a Fixed Sum (U.S.), the Supplementary Conditions for a Fixed Sum (U.S.), and the Specifications (Divisions 01 through 49) contained in the Project Manual entitled _____, dated _____ and prepared by _____ ("Architect");
      3) The Drawings prepared by Architect entitled _____, sheet numbers _____, dated _____;
      4) Addendum No. _____ dated _____; and
      5) All Modifications to the Contract Documents.
   b. The Contract Documents are incorporated into this Agreement by reference as if fully set forth herein.
   c. The definitions set forth in the General Conditions for a Fixed Sum (U.S.) will apply to the Contract Documents.
   d. The Contract Documents contain the entire and integrated agreement between the parties hereto and supersede all prior negotiations, representations, or agreements, either written or oral.
   e. Modifications or other amendments to the Contract Documents must be in writing and as provided in the General Conditions for a Fixed Sum (U.S.).

4. **Time of Commencement and Substantial Completion.**
   a. Contractor will commence the Work on the date for commencement set forth in the Written Notice to proceed from Owner to Contractor.
   b. Contractor will achieve Substantial Completion and have the Work ready for Owner's inspection no later than _____ (_____) days from the date of commencement set forth in the Written Notice to proceed from Owner to Contractor, as adjusted in accordance with the Contract Documents.
   c. Time is of the essence.

5. **Contract Sum.**
   a. Owner will pay Contractor for performance of Contractor's obligations under the Contract Documents the Contract Sum in the amount of _____ Dollars ($_____), subject to additions and deductions as provided in the Contract Documents.
   b. Owner will make payments to Contractor in accordance with the Contract Documents.

6. **Independent Contractor Relationship.** Contractor is an independent contractor and is not the agent or employee of Owner.

7. **Assignment.** Neither party to this Agreement will assign any right or obligation hereunder without the prior written consent of the other, which consent may be granted or withheld in such party's absolute discretion. Contractor will not assign moneys due or to become due to Contractor hereunder, nor will Contractor pledge the credit of Owner or bind Owner to any third party.

8. **Notice.** The parties designate the addresses, facsimile numbers, and email addresses as set forth in the signature blocks below to be used for sending Written Notice to the other party:

9. **Effective Date.** The effective date of this Agreement is the date indicated by the Owner's signature.

OWNER:	**CONTRACTOR:**
The Church of Jesus Christ of Latter-day Saints, a Utah corporation sole	(company)
Signature:	Signature:
Print Name:	Print Name:
Title:	Title:
Address:	Address:
Telephone No:	Telephone No:
Facsimile No:	Facsimile No:
Email:	Email:
Effective Date:	Fed. I.D. or SSN:
	License No:
Reviewed By:	Date Signed:

GENERAL CONDITIONS
For a Fixed Sum (U.S.)

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SECTION 1 - GENERAL PROVISIONS

1.1 DEFINITIONS

A. Adverse Weather: weather conditions that are seasonally abnormal and could not have been reasonably anticipated.

B. Agreement: the document entitled "Agreement Between Owner and Contractor for a Fixed Sum (U.S.), executed by Owner and Contractor for performance of the Work.

C. Architect: the entity identified as such in the Agreement.

D. Change In The Work: a modification to the requirements of the Contract Documents or a delay in Substantial Completion resulting from an instruction from Owner or Architect to Contractor or from another event or circumstance.

E. Change Order: a written instrument prepared by Architect and signed by Owner, Contractor, and Architect stating their agreement upon the following: (1) the occurrence of a Change in the Work; (2) the amount of the adjustment, if any, in the Contract Sum as a result of the Change in the Work; and (3) the extent of the adjustment, if any, in the Contract Time as a result of the Change in the Work.

F. Construction Change Directive: a written order prepared by Architect and signed by Architect and Owner which: (1) orders a Change in the Work if the terms of a Change Order cannot be agreed upon prior to performance of a Change in the Work described in Section 7.1 or after occurrence of an event or circumstance described in Section 7.2; and (2) states a proposed basis for adjustment, if any, in the Contract Sum, the Contract Time, or both, resulting from the Change in the Work.

G. Contract Documents: the documents identified as such in the Agreement.

H. Contract Sum: the total amount set forth in the Agreement payable by Owner to Contractor for performance of the Work.

I. Contract Time: the period of time set forth in the Agreement for the Substantial Completion of the Work.

J. Contractor: the entity identified as such in the Agreement.

K. Day: calendar day unless otherwise specifically defined.

L. Direct Costs: actual costs for labor, materials, equipment, insurance, bonds, subcontract costs and onsite supervision relating to the Project. They do not include labor costs for project managers or other off-site administration.

M. Drawings: the documents identified as such in the Agreement.

N. Field Change: a written order prepared by Architect and signed by Architect and Contractor for a minor Change in the Work consistent with the general intent of the Contract Documents costing $1,000 or less, resulting in no time extension, and which is necessary to avoid delaying the Work.

O. Modification: a written amendment to the Contract Documents in the form of a:
1. Change Order;
2. Construction Change Directive; or
3. Field Change.

P. Owner: the entity identified as such in the Agreement.

Q. Project: the total construction designed by Architect of which the Work performed under the Contract Documents may be the whole or a part.

R. Product Data: standard illustrations, schedules, performance charts, instructions, brochures, diagrams, and other information furnished by Contractor to illustrate details regarding materials or equipment to be used in the Work, or the manner of installation, operation, or maintenance of such materials or equipment.

S. Project Manual: the document identified as such in the Agreement.

T. Samples And Mock-ups: physical examples that illustrate materials, equipment, or workmanship and establish standards by which the Work will be judged.

U. Shop Drawings: drawings, diagrams, illustrations, schedules, performance charts, fabrication and installation drawings, setting diagrams, patterns, templates, and other data which illustrate some portion of the Work and confirm dimensions and conformance to the Contract Documents specially prepared by Contractor or any Subcontractor, manufacturer, supplier, or distributor.

V. Specifications: the documents identified as such in the Agreement.

W. Subcontractor: any entity supplying labor, materials, equipment, construction or services for the Work under separate contract with Contractor or any other Subcontractor.

X, Submittals: Shop Drawings, Product Data, Samples and Mock-ups and any other documents or items furnished by Contractor or its Subcontractors to Owner or Architect to demonstrate how any portion of the Work will be accomplished or the type of materials or products that will be used in the Work.

Y. Substantial Completion: Completion of the Work to a point where Owner can use the Work for its intended purposes. The date of Substantial Completion is the date certified as such by Architect in accordance with the Contract Documents.

Z. Work: all labor, materials, equipment, construction, and services required by the Contract Documents.

AA. Written Notice: notice in writing given from one party to the other at the addresses or facsimile numbers listed in the Agreement, or at such other addresses or facsimile numbers as the parties will designate from time to time by Written Notice, and will be effective at the earliest of:
1. The date of personal delivery to the other party with signed acknowledgment of receipt; or
2. The date sent by facsimile transmission to the other party provided receipt of the facsimile is verified by an electronic confirmation report by the party sending the facsimile transmission and further provided that a confirmation copy is sent to the other party by courier or by registered or certified mail within twenty-four (24) hours after the time and date of the facsimile transmission; or
3. The date of receipt by the other party as stated on the return receipt if sent by registered or certified mail, or by courier.

1.2 CORRELATION AND INTENT OF CONTRACT DOCUMENTS

A. The intent of the Contract Documents is to require Contractor to provide all labor, materials, equipment, construction, and services necessary for the proper execution and completion of the Work. The Contract Documents are complementary and what is required by any one will be as binding as if required by all. Contractor will perform the Work in accordance with the requirements expressly set forth in or reasonably inferable from the Contract Documents.

B. The organization of the Contract Documents is not intended to control Contractor in dividing the Work among Subcontractors or to establish the extent of the Work to be performed by any trade.

C. Words used in the Contract Documents that have well known technical or trade meanings are used therein in accordance with such recognized meanings.

D. In the interest of brevity, the Contract Documents may 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.

1.3 OWNERSHIP AND USE OF CONTRACT DOCUMENTS

The Drawings, the Project Manual, and copies thereof are the property of Owner. Contractor will not use these documents on any other project. Contractor may retain one copy of the Drawings and the Project Manual as a contract record set and will return or destroy all remaining copies following final completion of the Work.

1.4 PUBLIC STATEMENTS REGARDING PROJECT

Contractor will not make any statements or provide any information to the media about the Project without the prior written consent of Owner. If Contractor receives any requests for information from media, Contractor will refer such requests to Owner.

1.5 OWNERSHIP AND USE OF RENDERINGS AND PHOTOGRAPHS

Renderings representing the Work are the property of Owner. All photographs of the Work, whether taken during performance of the Work or at completion, are the property of the Owner. The Owner reserves all rights including copyrights to renderings and photographs of the Work. No renderings or photographs shall be used or distributed without written consent of the Owner

1.6 NO COMMERCIAL USE OF TRANSACTION OR RELATIONSHIP

Without the prior written consent of Owner, which Owner may grant or withhold in its sole discretion, neither Contractor nor Contractor's affiliates, officers, directors, agents, representatives, shareholders, members, Subcontractors, Sub-subcontractors or employees shall make any private commercial use of their relationship to Owner or the Project, including, without limitation:

A. By referring to this Agreement, Owner, or the Project verbally or in any sales, marketing or other literature, letters, client lists, press releases, brochures or other written materials except as may be necessary for Contractor to perform Contractor's obligations under the terms of this Agreement;

B. By using or allowing the use of any photographs of the Project or any part thereof, or of any service marks, trademarks or trade names or other intellectual property now or which may hereafter be associated with, owned by or licensed by Owner in connection with any service or product; or

C. By contracting with or receiving money or anything of value from any person or commercial entity to facilitate such person or entity obtaining any type of commercial identification, advertising or visibility in connection with the Project.

Notwithstanding the foregoing, Contractor may include a reference to Owner and the services and equipment provided under this Agreement in a professional résumé or other similar listing of Contractor's references without seeking Owner's written consent in each instance; provided, that such reference to Owner, the services and equipment is included with at least several other similar references and is given no more prominence than such other references.

1.7 CONFIDENTIALITY / PROPERTY RIGHTS

A. Owner will retain ownership and intellectual property rights in all plans, designs, drawings, documents, concepts, and materials provided by or on behalf of Owner to Contractor and to all work products of Contractor for or relative to Work performed under this Agreement, such products, services, and Work of Contractor constituting works made for hire. Contractor will not reuse any portions of such items provided by Owner or developed by Contractor for Owner pursuant to this Agreement, or disclose any such items to any third party without the prior written consent of Owner. Owner may withhold its consent in its' absolute discretion.

B. In addition, Contractor shall ensure that Contractor, Subcontractors, and the employees, agents and representatives of Contractor and its Subcontractors maintain in strict confidence, and shall use and disclose only as authorized by Owner all Confidential Information of Owner that Contractor receives in connection with the performance of this Agreement. Notwithstanding the foregoing, Contractor may use and disclose any information to the extent required by an order of any court or governmental authority, but only after it has notified Owner and Owner has had an opportunity to obtain reasonable protection for such information in connection with such disclosure. For purposes of this Agreement, "Confidential Information" means:
   1. The name or address of any affiliate, customer or contractor of Owner or any information concerning the transactions of any such person with Owner;
   2. Any information relating to contracts, agreements, business plans, budgets or other financial information of Owner to the extent such information has not been made available to the public by the Owner; and
   3. Any other information that is marked or noted as confidential by the Owner at the time of its disclosure.

1.8 COMPLY WITH INTELLECTUAL PROPERTY RIGHTS OF OTHERS

Contractor represents and warrants that no Work (with its means, methods, goods, and services attendant thereto), provided to Owner will infringe or violate any right of any third party and that Owner may use and exploit such Work, means, methods, goods, and services without liability or obligation to any person or entity (specifically and without limitation, such Work, means, methods, goods, and services will not violate rights under any patent, copyright, trademark, or other intellectual property right or application for the same).

SECTION 2 - OWNER

2.1 OWNER'S DESIGNATED REPRESENTATIVE

Owner will designate in writing a representative who will have express authority to bind Owner with respect to all matters requiring Owner's approval or authorization.

2.2 INFORMATION AND SERVICES REQUIRED OF OWNER

A. Owner will be responsible for establishment of property lines and benchmarks for grading.

B. Owner will furnish to Contractor any information or services it is required to furnish under the Contract Documents with reasonable promptness to avoid delay in the orderly progress of the Work.

C. Owner will furnish to Contractor a reasonable number of copies of the Drawings, the Project Manual, and the Addenda.

2.3 OWNER'S RIGHT TO INSPECT THE WORK

Owner and its representatives will have the right to inspect any portion of the Work wherever located at any time.

2.4 OWNER'S RIGHT TO STOP THE WORK

If Contractor fails to carry out the Work in accordance with the Contract Documents or fails to correct Work which is not in accordance with the Contract Documents in a timely manner, Owner may order Contractor in writing to stop the Work, or any portion thereof, until the cause for that order has been eliminated.

SECTION 3 - CONTRACTOR

3.1 REVIEW OF CONTRACT DOCUMENTS AND FIELD CONDITIONS BY CONTRACTOR

A. By executing the Agreement, Contractor represents that it has visited the Project site, familiarized itself with the local conditions under which the Work is to be performed, and correlated its own observations with the requirements of the Contract Documents.

B. Contractor will carefully review and compare the Contract Documents and any other available information relating to the Project prior to commencing and during performance of each portion of the Work and will immediately report to Architect any errors, inconsistencies, and omissions it discovers.

C. Should Contractor or any of its Subcontractors become aware of any question regarding the meaning or intent of any part of the Contract Documents prior to commencing that portion of the Work about which there is a question, Contractor will request an interpretation or clarification from Architect before proceeding. Contractor proceeds at its own risk if it proceeds with the Work without first making such a request and receiving an interpretation or clarification from Architect. If neither Contractor nor its Subcontractors become aware of the question until after work on the relevant portion of the Work has commenced, then the following precedence will govern for purposes of determining whether resolution of the question constitutes a Change in the Work:
   1. The Agreement takes precedence over all other Contract Documents.
   2. The Supplementary Conditions take precedence over the General Conditions.
   3. The General Conditions and Supplementary Conditions take precedence over the Drawings and the Specifications.
   4. An Addendum or a Modification takes precedence over the document(s) modified by the Addendum or Modification.
   5. The Specifications take precedence over the Drawings.
   6. Within the Drawings, larger scale drawings take precedence over smaller scale drawings, figured dimensions over scaled dimensions, and noted materials over graphic indications.

D. Contractor will give Architect notice of any additional drawings, specifications, or instructions required to define the Work in greater detail, or to permit the proper progress of the Work, sufficiently in advance of the need for information so as not to delay the Work.

E. It is not Contractor's responsibility to ascertain that the Contract Documents are in accordance with requirements of applicable laws, statutes, ordinances, building codes, rules and regulations. However, if Contractor observes that portions of the Contract Documents are at variance with those requirements, Contractor will immediately notify Architect in writing. Contractor will not proceed unless Owner and/or Architect effects Modifications to the Contract Documents required for compliance with such requirements. Contractor will be fully responsible for any work knowingly performed contrary to such requirements and will fully indemnify Owner against loss and bear all costs and penalties arising therefrom.

F. Contractor will take field measurements and verify field conditions and will compare such field measurements and conditions and other information known to Contractor with the Contract Documents before ordering any materials or commencing construction activities. Contractor will immediately report errors, inconsistencies, and omissions that it discovers to Architect. If Contractor orders materials or commences construction activities before taking field measurements and verifying field conditions, Contractor will not be entitled to any compensation for additional costs to Contractor resulting from field measurements or conditions different from those anticipated by Contractor which would have been avoided had Contractor taken field measurements and verified field conditions prior to ordering the materials or commencing construction activities.

G. If site conditions indicated in the Contract Documents or other information provided by Owner or Architect to Contractor differ materially from those Contractor encounters in performance of the Work, Contractor will immediately notify Architect in writing of such differing site conditions.

H. Where the Contract Documents require the Contractor to provide professional services for architecture or engineering, the Contractor shall cause such services to be performed by appropriately licensed professionals.

3.2 SUPERVISION OF CONSTRUCTION PROCEDURES

A. Contractor will supervise and direct the Work. Contractor will be solely responsible for all construction means, methods, techniques, sequences, and procedures and for coordinating all portions of the Work. All loss, damage, liability, or cost of correcting defective work arising from the use of any construction means, methods, techniques, sequences or procedures will be borne by Contractor, notwithstanding that such construction means, methods, techniques, sequences or procedures are referred to, indicated or implied by the Contract Documents, unless Contractor has given timely notice to Owner and Architect in writing that such means, methods, techniques, sequences or procedures are not safe or suitable, and Owner has then instructed Contractor in writing to proceed at Owner’s risk.

B. Contractor will utilize its best skill, efforts, and judgment to provide efficient business administration and supervision, to furnish at all times an adequate supply of workers and materials, and to perform the Work in an expeditious and economical manner consistent with the interests of Owner.

C. Contractor will be responsible for:
   1. The proper observance of property lines and set back requirements as shown in the Contract Documents;

2. The location and layout of the Work as shown in the Contract Documents with respect to the position of the Work on the property and the elevation of the Work in relation to grade; and
3. Setting and maintaining construction stakes.

D. Contractor will be responsible to Owner for the acts and omissions of its employees and Subcontractors as well as persons either directly or indirectly employed by Subcontractors.

E. Contractor will not be relieved of its obligation to perform the Work in accordance with the Contract Documents as a result of any tests, inspections, or approvals by Owner, Architect or their consultants.

F. Contractor will be responsible for inspection of portions of the Work already completed to determine that such portions are in proper condition to receive subsequent portions of the Work.

G. Contractor recognizes that the Project site and the surrounding area is frequently visited by the public and is important to Owner's image and function and will maintain the premises free from debris and waste materials resulting from Construction. At the completion of Construction, Contractor shall promptly remove construction equipment, tools, surplus materials, waste materials and debris.

3.3 LABOR AND MATERIALS

A. Unless otherwise provided in the Contract Documents, Contractor will provide and pay for all labor, materials, equipment, tools, water, heat, utilities, transportation, and other facilities and services necessary for the proper execution and completion of the Work.

B. Contractor will at all times enforce strict discipline and good order among those performing the Work and will not permit employment of any unfit person or anyone not skilled in the tasks assigned to them.

C. Contractor is fully responsible for the Project and all materials and work connected therewith until Owner has accepted the Work in writing. Contractor will replace or repair at its own expense any materials or work damaged or stolen, regardless of whether it has received payment for such work or materials from the Owner.

D. Contractor will remedy all damage or loss to any property caused in whole or in part by Contractor, any Subcontractor, or by anyone for whose acts any of them may be liable.

E. Contractor will be responsible for determining that all materials furnished for the Work meet all requirements of the Contract Documents. Architect may require Contractor to produce reasonable evidence that a material meets such requirements, such as certified reports of past tests by qualified testing laboratories, reports of studies by qualified experts, or other evidence which, in the opinion of Architect, would lead to a reasonable certainty that any material used, or proposed to be used, in the work meets the requirements of the Contract Documents. All such data will be furnished at Contractor's expense. This provision will not require Contractor to pay for periodic testing of different batches of the same material, unless such testing is specifically required by the Contract Documents to be performed at Contractor's expense.

F. Contractor will coordinate and supervise the work performed by Subcontractors so that the Work is carried out without conflict between trades and so that no trade, at any time, causes delay to the general progress of the Work. Contractor and all Subcontractors will at all times afford each trade, any separate contractor, or Owner, reasonable opportunity for the installation of Work and the storage of materials.

G. Contractor warrants to Owner that the materials and equipment furnished for the Work will be new unless otherwise specified by the Contract Documents, and that the Work will be free from defects, and will conform with the requirements of the Contract Documents. Work not conforming to these requirements, including substitutions not properly approved and authorized, may be considered defective in the discretion of Owner. If required by Architect, Contractor will furnish satisfactory evidence as to the kind and quality of the materials and equipment used in performing the Work.

H. Owner may elect to purchase materials required for the Work. In that event, Contractor will comply with the procedures set forth in the Contract Documents relating to such materials.

3.4 COMPLIANCE WITH LAWS

Contractor will comply with all applicable laws, ordinances, rules, regulations, and orders of any public authorities relating to performance of the Work.

3.5 TAXES

A. Contractor will pay all sales, use, consumer, payroll, workers compensation, unemployment, old age pension, surtax, and similar taxes assessed in connection with the performance of the Work.

B. Owner will pay all taxes and assessments on the real property comprising the Project site.

3.6 PERMITS AND FEES

A. Owner will obtain and pay for all zoning and use permits and permanent easements necessary for completion of the Work.

B. Contractor will obtain and pay for the building permit, and all other permits, governmental fees, licenses and inspections necessary for the proper execution and completion of the Work.

C. Contractor will secure any certificates of inspection and of occupancy required by authorities having jurisdiction over the Work. Contractor will deliver these certificates to Architect prior to issuance of the Certificate of Substantial Completion by Architect.

3.7 CONTRACTOR'S ON-SITE REPRESENTATIVE

Contractor will employ a competent representative acceptable to Owner to supervise the performance of the Work. This representative will be designated in writing by Contractor prior to commencement of work and will not be changed prior to final inspection of the Work without prior written consent of Owner. This representative will represent Contractor for all purposes, including communication with Owner.

3.8 CONTRACTOR'S CONSTRUCTION SCHEDULES

A. Contractor will prepare and submit for Owner's and Architect's information Contractor's construction schedule for the Work in accordance with the requirements of the Contract Documents.

B. Contractor will prepare and maintain a Submittal schedule which is coordinated with Contractor's construction schedule and sets forth specified times for Architect to review Submittals.

3.9 DOCUMENTS AND SUBMITTALS AT THE SITE

Contractor will keep at the Project site for use by Owner, Architect, or their representatives, a record copy of the Project Manual, the Drawings, all Addenda, and all Modifications. These documents will be maintained in good order and currently marked to record changes and selections made during construction. In addition, Contractor will keep at the Project site one copy of all Submittals.

3.10 SUBMITTALS

A. Submittals are not Contract Documents and do not alter the requirements of the Contract Documents unless incorporated into the Contract Documents by a Modification.

B. Contractor will review, approve, and submit to Architect Submittals in accordance with the Contract Documents. By approving Submittals, Contractor represents that it has determined and verified field measurements, field construction criteria, materials, catalog numbers, and similar data, and that it has checked and coordinated each Submittal with the requirements of the Work and of the Contract Documents or will make such determination, verification, check, and coordination prior to commencing the relevant portion of the Work. In reviewing Submittals Architect will be entitled to rely upon Contractor’s representation that such information is correct and accurate.

C. Contractor will inform Architect in writing at the time of submission of any Submittal or portion thereof which deviates from the requirements of the Contract Documents. Contractor will provide Architect with documentation demonstrating to Architect that the Submittal is equal to or better than the specified product or work. Contractor will not be relieved of responsibility for deviations from the requirements of the Contract Documents by Architect’s acceptance of a Submittal unless Contractor has informed Architect in writing of the deviation and Architect has incorporated the deviation into the Contract Documents by a Modification.

D. Contractor will not perform any portions of the Work requiring Submittals until the respective Submittal has been reviewed and accepted in writing by Architect.

E. When professional certification of performance criteria of materials, systems or equipment is required by the Contract Documents, Owner will be entitled to rely upon such certifications, and neither Owner nor Architect will be expected to make any independent examination with respect thereto.

F. Submittals not required by the Contract Documents may be returned to Contractor without action.

3.11 CUTTING AND PATCHING

Contractor will be responsible for any cutting, fitting, and patching that may be required to complete the Work and make its parts fit together properly.

3.12 ACCESS TO WORK

Contractor will permit Owner, Architect, their representatives and consultants, access to the Work wherever located at any time.

3.13 ROYALTIES AND PATENTS

Contractor will pay all royalties and license fees required by the Work or by Contractor's chosen method of performing the Work. Contractor will defend and hold Owner harmless from all suits or claims for infringement of any patent, license or other intellectual property rights or any loss on account thereof.

3.14 INDEMNIFICATION

A. Contractor will indemnify and hold harmless Owner and Owner's representatives, employees, agents, architects, and consultants from and against any and all claims, damages, liability, demands, costs, judgments, awards, settlements, causes of action, losses and expenses (collectively “Claims” or “Claim”), including but not limited to attorney fees, consultant fees, expert fees, copy costs, and other expenses, arising out of or resulting from performance of the Work, attributable to bodily injury, sickness, disease, or death, or to injury to or destruction of real or personal property, including loss of use resulting therefrom, except to the extent that such liability arises out of the negligence of Owner, its representatives, agents, and employees. This indemnity includes, without limitation, indemnification of Owner from all losses or injury to Owner’s property, except to the extent that such loss or injury arises out of the negligence of Owner, its representatives, agents, and employees. This indemnity applies, without limitation, to include Claims occurring both during performance of the Work and/or subsequent to completion of the Work. In the event that any Claim is caused in part by a party indemnified hereunder, that party will bear the cost of such Claim to the extent it was the cause thereof. In the event that a claimant asserts a Claim for recovery against any party indemnified hereunder, the party indemnified hereunder may tender the defense of such Claim to Contractor. If Contractor rejects such tender of defense and it is later determined that the negligence of the party indemnified hereunder did not cause all of the Claim, Contractor will reimburse the party indemnified hereunder for all costs and expenses incurred by that party in defending against the Claim. Contractor will not be liable hereunder to indemnify any party for damages resulting from the sole negligence of that party.

B. In addition to the foregoing, Contractor will be liable to defend Owner in any lawsuit filed by any Subcontractor relating to the Project. Where liens have been filed against Owner's property, Contractor (and/or its bonding company which has issued bonds for the Project) will obtain lien releases and record them in the appropriate county and/or local jurisdiction and provide Owner with a title free and clear from any liens of Subcontractors. In the event that Contractor and/or its bonding company are unable to obtain a lien release, Owner in its absolute discretion may require Contractor to provide a bond around the lien or a bond to discharge the lien, at Contractor's sole expense.

C. In addition to the foregoing, Contractor will indemnify and hold Owner harmless from any claim of any other contractor resulting from the performance, nonperformance or delay in performance of the Work by Contractor.

D. The indemnification obligation herein will not be limited by a limitation on the amount or type of damages, compensation or benefits payable by or for Contractor or a Subcontractor under worker's compensation acts, disability benefit acts, or other employee benefit acts.

3.15 PROJECT MEETINGS

Contractor will attend and participate in meetings as required by the Contract Documents.

SECTION 4 - ADMINISTRATION OF THE CONTRACT

4.1 ARCHITECT

In the event that Owner terminates its contractual relationship with Architect, Owner will appoint in writing another architect, whose status under the Contract Documents will be that of the former Architect in all respects.

4.2 ARCHITECT'S ADMINISTRATION OF THE CONTRACT

A. Architect will make periodic visits to the site to familiarize itself generally with the progress and quality of the Work and to determine if the Work is proceeding in accordance with the Contract Documents. Although Architect is required to make periodic inspections, it is not required to make exhaustive or continuous onsite inspections. On the basis of its observations while at the site, Architect will keep Owner informed of the progress of the Work and will endeavor to guard Owner against defects and deficiencies in the Work. Architect’s failure to observe a defect or deficiency in the Work will not relieve Contractor of its duty to perform the Work in accordance with the Contract Documents.

B. Architect will review Contractor's payment requests and determine the amounts due Contractor in accordance with Section 9.

C. Communications between Contractor and Owner relating to the Work will be through Architect. Communications between Owner or Contractor with Architect’s consultants relating to the Work will be through Architect. Communications between Owner or Architect and subcontractors relating to the Work will be through Contractor. Communications between Contractor and any separate contractor will be through Architect, except as otherwise specified in the Contract Documents.

D. Owner and/or Architect will have the right to reject and require removal of the following at Contractor's expense:
   1. Any portion of the Work that does not meet the requirements of the Contract Documents.
   2. Any portion of the Work damaged or rendered unsuitable during installation or resulting from failure to exercise proper protection.

E. Architect will have authority to suspend the Work, with concurrence of Owner, whenever such suspension may be necessary in its reasonable opinion to insure the proper performance of the Work.

F. Architect will review Contractor’s Submittals and will accept or take other appropriate action regarding the Submittals. Architect's review of the Submittals will be for the limited purpose of checking for general conformance with the Contract Documents and will not be conducted for the purpose of determining the accuracy and completeness of 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 Contractor. Architect's review of Submittals will not relieve Contractor of its obligations under the Contract Documents. Architect's review of Submittals will not constitute acceptance of safety precautions or construction

means, methods, techniques, sequences or procedures. Architect's acceptance of a specific item will not indicate acceptance of an assembly of which the item is a component.

G. Architect has authority to order Construction Change Directives and Field Changes in accordance with Section 7.

H. Architect will conduct inspections to determine the dates of Substantial Completion and final completion, will receive and review written guarantees and related documents required by the Contract and assembled by Contractor, and will review and certify or reject Contractor's final payment request.

I. Architect will be the interpreter of the performance and requirements of the Contract Documents. Architect's interpretations will be in writing or in the form of drawings.

J. Architect's decisions in matters relating to aesthetic effect will be final if consistent with the Contract Documents and approved by Owner.

SECTION 5 - SUBCONTRACTORS

5.1 AWARD OF SUBCONTRACTS FOR PORTIONS OF THE WORK

A. Contractor will enter into contracts with Subcontractors to perform all portions of the Work that Contractor does not customarily perform with its own employees.

B. Contractor will not contract with any Subcontractor who has been rejected by Owner. Contractor will not be required to contract with any Subcontractor against whom it has a reasonable objection.

C. If Owner rejects any Subcontractor proposed by Contractor, Contractor will propose an acceptable substitute to whom Owner has no reasonable objection.

D. Contractor will not make any substitution for any Subcontractor that has been accepted by Owner and Architect without the prior written approval of Owner and Architect.

5.2 SUBCONTRACTUAL RELATIONS

A. Contractor's responsibility for the Work includes the labor and materials of all Subcontractors, including those recommended or approved by Owner. Contractor will be responsible to Owner for proper completion and guarantee of all workmanship and materials under any subcontracts. Any warranties required for such work will be obtained by Contractor in favor of Owner and delivered to Architect. It is expressly understood and agreed that there is no contractual relationship between Owner and any Subcontractor, and under no circumstances will Owner be responsible for the non-performance or financial failure of any Subcontractor or any effects therefrom.

B. Contractor agrees to pay the Subcontractors promptly upon receipt of payment from Owner for that portion of the funds received which represents the Subcontractor's portion of the Work completed to Contractor's satisfaction for which Owner has made payment.

C. Contractor will require each Subcontractor to:
1. Be licensed by the state in which the Project is located where such licensing is required by the governing authority;
2. Be bound by the terms of the Contract Documents as far as they are applicable to the Subcontractor's work;
3. Assume toward Contractor the same obligations Contractor has assumed toward Owner, including the prompt payment of its Subcontractors;
4. Submit its applications for payment to Contractor in time to permit Contractor to make timely application to Owner;
5. Execute claim or lien releases or lien waivers for payments made by Contractor; and
6. Make all claims for Changes in the Work to Contractor in the same manner as Contractor is required to make such claims to Owner.

SECTION 6 - CONSTRUCTION BY OWNER OR BY SEPARATE CONTRACTORS

6.1 OWNER'S RIGHT TO PERFORM WORK OR AWARD SEPARATE CONTRACTS

A. Owner reserves the right to perform work itself or to award separate contracts in connection with the Project.

B. When separate contracts are awarded, "Contractor" in the Contract Documents in each case will mean the contractor who signs each separate contract.

6.2 MUTUAL RESPONSIBILITY

A. Contractor will afford other contractors reasonable opportunity to place and store their materials and equipment on site and to perform their work and will properly connect and coordinate its Work with theirs where applicable.

B. If any part of Contractor's Work depends upon the work of any separate contractor for proper performance or results, Contractor will inspect and promptly report to Architect any apparent discrepancies or defects in such work that render it unsuitable for

proper performance and results. Failure of Contractor to so inspect and report will constitute an acceptance of the work of the separate contractor as fit and proper to receive Contractor's Work, except as to defects not then reasonably discoverable.

C. Contractor will promptly remedy damage caused by Contractor or any Subcontractor to the completed or partially completed work of other contractors or to the property of Owner or other contractors.

6.3 OWNER'S RIGHT TO CLEAN UP

If a dispute arises among Contractor and separate contractors as to the responsibility under their separate contracts for maintaining the Project free from waste materials and rubbish, Owner may clean the Project, allocate the cost among those responsible as Owner and Architect determine to be just, and withhold such cost from any amounts due or to become due to Contractor.

SECTION 7 - CHANGES IN THE WORK

7.1 CHANGES IN THE WORK RESULTING FROM AN INSTRUCTION BY OWNER OR ARCHITECT TO CONTRACTOR

A. If Owner or Architect gives Contractor an instruction that modifies the requirements of the Contract Documents or delays Substantial Completion, Contractor may be entitled to an adjustment in the Contract Sum and/or the Contract Time. If compliance with the instruction affects the cost to Contractor to perform the Work, the Contract Sum will be adjusted to reflect the reasonable increase or decrease in cost subject to the conditions set forth in Section 7.1, Paragraphs B through G. If compliance with the instruction delays Substantial Completion, the Contract Time will be extended for a period of time commensurate with such delay subject to the conditions set forth in Section 7.1, Paragraphs B through G and Section 7.3, Paragraph A and Contractor will be paid liquidated damages for the delay as set forth in Section 7.3, Paragraph B.

B. If Contractor receives an instruction from Owner or Architect that Contractor considers to be a Change in the Work, Contractor, before complying with the instruction, will notify Architect in writing that Contractor considers such instruction to constitute a Change in the Work. If Architect agrees that compliance with the instruction will constitute a Change in the Work, Contractor will furnish a proposal for a Modification in accordance with Section 7.1, Paragraphs C. and D. within ten (10) days.

C. If Contractor claims that it is entitled to an adjustment in the Contract Sum (including without limitation costs related to a time extension) as a result of an instruction by Owner or Architect, Contractor will furnish a proposal for a Change Order containing a price breakdown itemized as required by Owner. The breakdown will be in sufficient detail to allow Owner to determine any increase or decrease in Direct Costs as a result of compliance with the instruction. Any amount claimed for subcontracts will be supported by a similar price breakdown and will itemize the Subcontractor's profit and overhead charges. Profit and overhead will be subject to the following limitations:
   1. The Subcontractor's profit and overhead will not exceed ten (10) percent of its Direct Costs on work performed. Subcontractor's profit and overhead will not exceed five (5) percent on work performed by its sub-subcontractors.
   2. Contractor's profit and overhead on work performed by its own crews will not exceed ten (10) percent of its Direct Costs.
   3. Contractor's profit and overhead mark up on work performed by its Subcontractors will not exceed five (5) percent of the Subcontractors' charges for such work.
   4. Amounts due Owner as a result of a credit change will be the actual net savings to Contractor from the Change in the Work as confirmed by Architect. On credit changes, profit and overhead on the originally estimated work will not be credited back to Owner. If both additions and credits are involved in a single Change in the Work, overhead and profit will be figured on the basis of net increase, if any, related to that Change in the Work.

D. If Contractor claims that it is entitled to an adjustment in the Contract Time as a result of an instruction from Owner or Architect, Contractor will include in its proposal justification to support Contractor's claim that compliance with the instruction will delay Substantial Completion.

E. Upon receipt of Contractor's proposal for Modification, Architect and Owner will determine whether to proceed with the Change in the Work. If Architect and Owner determine to proceed with the Change in the Work, they will issue a Change Order, a Construction Change Directive or a Field Change as appropriate.

F. Contractor agrees that if it complies with an instruction from Owner or Architect without first giving written notice to Architect as provided in Section 7.1., Paragraph B, and receiving a Change Order, Construction Change Directive or Field Change, Contractor will not be entitled to any adjustment in the Contract Sum or the Contract Time as a result of the instruction and waives any claim therefor.

G. If Contractor is instructed to perform work which it claims constitutes a Change in the Work but which Owner and Architect do not agree constitutes a Change in the Work, Contractor will comply with the instruction. Contractor may submit its claim for adjustment to the Contract Sum, the Contract Time, or both as a dispute pursuant to Section 13 within thirty (30) days after compliance with the instruction. Contractor agrees that if it fails to submit its claim for resolution pursuant to Section 13 within thirty (30) days after compliance with the instruction, then Contractor will not be entitled to any adjustment in the Contract Sum or the Contract Time as a result of the instruction and waives any claim therefor.

H. Contractor agrees that it is responsible for submitting accurate cost and pricing data to support its Change Order Proposals. Owner will have the right to examine the Contractor's records to verify the accuracy and appropriateness of the pricing data used to price change order proposals.

7.2 CHANGE IN THE WORK RESULTING FROM AN EVENT OR CIRCUMSTANCE

A. If an event or circumstance other than an instruction from Owner or Architect affects the cost to Contractor of performing the Work or delays Substantial Completion, Contractor may be entitled to an adjustment in the Contract Sum and/or the Contract Time. If the circumstance or event affects the cost to Contractor to perform the Work and is caused by a willful or negligent act or omission of Owner or Architect, the Contract Sum will be adjusted to reflect the reasonable increase or decrease in Contractor's cost to perform the Work resulting from the event or circumstance, subject to the conditions set forth in Section 7.2, Paragraphs B through F. If the event or circumstance delays Substantial Completion and is described in Section 7.3, Paragraph A, the Contract Time will be extended for a period of time commensurate with such delay subject to the conditions set forth in such section. If the circumstance or event delays Substantial Completion and is caused by a willful or negligent act or omission of Owner or Architect, then Contractor will be compensated for costs incident to the delay in accordance with Section 7.3, Paragraph B. Contractor will not be entitled to any adjustment to the Contract Sum or other damages from Owner as a result of any event or circumstance unless the event or circumstance results from a willful or negligent act or omission of Owner or Architect.

B. If a Change in the Work results from any event or circumstance caused by the willful or negligent act or omission of Owner or Architect, Contractor will give Owner Written Notice of such event or circumstance within twenty-four (24) hours after commencement of the event or circumstance so that Owner can take such action as is necessary to mitigate the effect of the event or circumstance. Contractor will not be entitled to any adjustment in either the Contract Time or the Contract Sum based on any damages or delays resulting from such event or circumstance during a period more than twenty-four (24) hours prior to Contractor giving such Written Notice to Owner.

C. Contractor will submit in writing any claims for an adjustment in the Contract Time and/or the Contract Sum resulting from an event or circumstance within the time limits set forth below. In the event that Contractor fails to submit its claim in writing within the time limits set forth below, then Contractor agrees it will not be entitled to any adjustment in the Contract Time or the Contract Sum or to any other damages from Owner due to the circumstance or event and waives any claim therefor.
   1. Claims for an adjustment in the Contract Time due to Adverse Weather will be made by the tenth (10th) of the month following the month in which the delay occurred.
   2. Claims for an adjustment in the Contract Time and/or the Contract Sum due to any other circumstance or event will be submitted within seven (7) days after the occurrence of the circumstance or event.

D. If Contractor claims that it is entitled to an adjustment in the Contract Sum (including without limitation costs related to a time extension) because of an event or circumstance resulting from the willful or negligent act or omission of Owner or Architect, Contractor will furnish a proposal for a Change Order containing a price breakdown as described in Section 7.1, Paragraph C. Any amount claimed for increased labor costs as a result of the event or circumstance must be supported by a certified payroll. Any claim for rented equipment or additional material costs must be supported by invoices.

E. If Contractor claims that it is entitled to an adjustment in the Contract Time as a result of an event or circumstance, Contractor will include with its claim copies of daily logs, letters, shipping orders, delivery tickets, Project schedules, and other supporting information necessary to justify Contractor's claim that the event or circumstance delayed Substantial Completion. If Contractor is entitled to an adjustment in the Contract Time as a result of an event or circumstance caused by the wilful or negligent act or omission of Owner or Architect, Contractor will be compensated for all costs related to the delay in accordance with Section 7.3, Paragraph B.

F. Within thirty (30) days after receipt of Contractor's claim, Architect will either deny the claim or recommend approval to Owner. If Owner approves the claim, the adjustment in the Contract Time and/or Contract Sum will be reflected in a Change Order pursuant to Section 7.5 or a Construction Change Directive pursuant to Section 7.6. If Owner or Architect denies Contractor's claim, Contractor may submit its claim as a dispute pursuant to Section 13 within thirty (30) days of receipt of the denial of the claim. If Contractor fails to submit its claim for resolution pursuant to Section 13 within the thirty (30) day time period, then Contractor agrees it is not entitled to any adjustment in the Contract Time and/ or Contract Sum or any other damages as a result of the event or circumstance and waives any claim therefor.

7.3 EXTENSIONS OF TIME

A. If Substantial Completion of the Project is delayed because of any of the following causes, then the Contract Time will be extended by Change Order for a period of time equal to such delay:
   1. Labor strikes or lock-outs;
   2. Adverse weather;
   3. Unusual delay in transportation;
   4. Unforeseen governmental requests or requirements;
   5. A Change in the Work resulting from an instruction by Owner or Architect to Contractor subject to the conditions set forth in Section 7.1; or
   6. Any other event or circumstance caused by the willful or negligent act or omission of Owner or Architect.

B. Contractor will not be entitled to any compensation for delay described in Section 7.3, Paragraph A, subparagraphs 1, 2, 3 and 4. For each day of delay in Substantial Completion described in Section 7.3, Paragraph A, subparagraphs 5 and 6, Contractor will be paid liquidated damages in the amount per day set forth in the Supplementary Conditions to compensate Contractor for all damages resulting from any delay including but not limited to damages for general conditions costs, additional job site costs, additional home office overhead costs, disruption costs, acceleration costs, increase in labor costs, increase in subcontract costs, increase in materials costs, and any other costs incident to the delay. Contractor will be entitled to no other compensation relating to the delay.

C. In no event will any time extension or cost adjustment be given on account of delay which reasonably should have been anticipated by the Contractor or in circumstances where performance of the Work is, was, or would have been, delayed by any other cause for which the Contractor is not entitled to an extension.

7.4 DOCUMENTATION OF CHANGES IN THE WORK

Every Change in the Work will be documented by a Change Order, a Construction Change Directive or a Field Change. If Owner, Architect and Contractor reach agreement regarding the adjustment in the Contract Sum, if any, and the adjustment in the Contract Time, if any, resulting from a Change in the Work, then the parties will execute a Change Order pursuant to Section 7.5. If Owner, Architect and Contractor cannot reach agreement regarding the adjustment in Contract Sum or the adjustment in Contract Time resulting from a Change in the Work, then Owner and Architect will issue a Construction Change Directive pursuant to Section 7.6. Field Changes require the agreement of Architect and Contractor only.

7.5 CHANGE ORDERS

Contractor's signature upon a Change Order is Contractor's acknowledgment that it is not entitled to any additional adjustment in the Contract Sum or the Contract Time or any other damages or compensation as a result of the Change in the Work other than that provided for in the Change Order, irrespective of whether a subsequent claim for additional compensation or time extensions relating to the Change in the Work is described as a change in the requirements of the Contract Documents, a delay, a disruption of the Work, an acceleration of the Work, an impact on the efficiency of performance of the Work, an equitable adjustment, or other claim and irrespective of whether the impact of the Change in the Work is considered singly or in conjunction with the impact of other Changes in the Work.

7.6 CONSTRUCTION CHANGE DIRECTIVES

A. Contractor will promptly comply with all Construction Change Directives.

B. Pending final resolution of any adjustment in the Contract Sum or Contract Time relating to a Construction Change Directive, the amounts proposed by Owner in the Construction Change Directive may be included in Contractor's payment requests once the work relating thereto is completed.

C. If after the work described in the Construction Change Directive is completed, Owner, Architect, and Contractor reach agreement on adjustments in the Contract Sum, Contract Time, or both, such agreement will be reflected in an appropriate Change Order.

D. If the parties do not reach agreement regarding an adjustment to the Contract Sum, Contract Time, or both relating to the Construction Change Directive within thirty (30) days of the completion of the work described therein, then Contractor may submit its claim for an adjustment pursuant to Section 13 within thirty (30) days of the completion of such work. Contractor agrees that if it fails to submit its claim for resolution pursuant to Section 13 within thirty (30) days of completion of the work described in the Construction Change Directive, then it will not be entitled to an adjustment in Contract Sum or Contract Time resulting from such work except as set forth in the Construction Change Directive and waives any claim therefor.

7.7 FIELD CHANGES

Architect and Contractor will sign a Field Change order listing the Change In The Work and the Contract Sum including markups before Contractor proceeds with the Field Change.

7.8 WAIVER OF CLAIMS

Except as set forth in Section 7, Contractor will not be entitled to any adjustment in the Contract Sum or the Contract Time or for any damages of any kind whatsoever resulting from an instruction from Owner or Architect, any event or circumstance, or any act or omission of Owner or Architect and Contractor expressly waives any and all claims therefor.

SECTION 8 - TIME

8.1 TIME IS OF THE ESSENCE

All time limits stated in the Contract Documents are of the essence. By executing the Agreement, Contractor confirms that the Contract Time is a reasonable period for performing the Work. Contractor will proceed expeditiously with adequate resources and will achieve Substantial Completion within the Contract Time.

8.2 COMMENCEMENT OF THE WORK

Contractor will not commence work on the Project site until the date set forth in the Written Notice to proceed. However, Contractor may enter into subcontracts and secure material for the Project after receipt of the Agreement with Owner's authorized signature. Owner will issue the Written Notice to proceed within forty-five (45) days after Owner receives acceptable bonds and evidence of insurance pursuant to Section 11 unless Owner earlier terminates the Agreement pursuant to Section 14.

8.3 DELAY IN COMPLETION OF THE WORK

A. For each day after the expiration of the Contract Time that Contractor has not achieved Substantial Completion, Contractor will pay Owner the amount set forth in the Supplementary Conditions as liquidated damages for Owner's loss of use of the Project

and the added administrative expense to Owner to administer the Project during the period of delay. In addition, Contractor will reimburse Owner for any additional Architect's fees, attorney fees, expert fees, consultant fees, copy costs, and other expenses incurred by Owner as a result of the delay. Owner may deduct any liquidated damages or reimbursable expenses from any money due or to become due to Contractor. If the amount of liquidated damages and reimbursable expenses exceeds any amounts due to Contractor, Contractor will pay the difference to Owner within ten (10) days after receipt of a written request from Owner for payment.

B. At the time Architect certifies that Contractor has achieved Substantial Completion, Architect will identify the remaining items to be completed for final completion of the Work and will establish with Contractor a reasonable time for completion of those items. Architect will set forth the items to be completed and the time established for their completion in a Certificate of Substantial Completion. For each day that Contractor exceeds the time allowed for completion of the items set forth in the Certificate of Substantial Completion, Contractor will pay to Owner as liquidated damages for additional administrative expenses the amount set forth in the Supplementary Conditions. In addition, Contractor will reimburse Owner for any additional Architect's fees, attorney fees, expert fees, consultant fees, copy costs, and other expenses incurred by Owner as a result of the delay in completing such items.

SECTION 9 - PAYMENTS AND COMPLETION

9.1 SCHEDULE OF VALUES

Contractor will submit to Architect a schedule of values which allocates the Contract Sum to various portions of the Work. The schedule of values will be supported by such data to substantiate its accuracy as required by Architect. This schedule, when accepted by Owner and Architect, will be used as a basis for reviewing Contractor's payment requests.

9.2 PAYMENT REQUESTS

A. Not more than once a month, Contractor will submit a payment request to Architect for Work completed, materials stored on the site, and for materials stored offsite as of the date of the payment request. The amount of the payment request will be based upon the schedule of values and will be equal to the value of the Work completed:
   1. Less retention;
   2. Less all prior amounts paid by Owner to Contractor as part of the Contract Sum; and
   3. Less allowable offsets.

   The payment request may include Changes in the Work that have been performed by Contractor and authorized by Owner and/or Architect pursuant to Section 7. If a payment request includes materials stored offsite, Contractor will include with the payment request a list of the materials, the location where they are stored and the written request of Contractor and its performance bond surety that payment be made for such materials.

B. Contractor warrants and guarantees that upon the receipt of payment for materials and equipment, whether incorporated in the Project or not, title to such materials and equipment will pass to Owner free and clear of all liens, claims, security interests, or encumbrances. Notwithstanding this payment and passage of title, Contractor will remain responsible for all such materials and equipment until actual delivery to the project site, incorporation into the Work, and final acceptance by Owner. Contractor further warrants that no material or equipment covered by a payment request is subject to an agreement under which an interest therein or an encumbrance thereon is retained by the seller or any other person or entity.

9.3 PAYMENT REQUEST CERTIFICATION

A. Architect will, within seven (7) days after receipt of Contractor's payment request, forward to Owner the payment request certified for such amount as Architect determines is properly due. If Architect certifies less than the full amount of the payment request, Architect will notify Contractor and Owner of Architect's reasons for withholding certification of the full amount requested.

B. The certification of the payment request will constitute a representation by Architect to Owner based upon Architect's observations at the site and the data comprising the payment request, that the Work has progressed to the point indicated and that, to the best of Architect's knowledge, information, and belief, 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 minor deviations from the Contract Documents correctable prior to completion, and to specific qualifications expressed by Architect. However, the certification of the payment request will not constitute a representation that Architect has:
   1. Conducted exhaustive or continuous on-site inspections to check the quantity or quality of the Work;
   2. Reviewed construction means, methods, techniques, sequences, or procedures;
   3. Reviewed copies of requisitions received from Subcontractors or other data requested by Owner to substantiate Contractor's right to payment; or
   4. Made examination to ascertain how or for what purpose Contractor has used money previously paid on account of the Contract Sum.

C. In taking action on Contractor’s payment request, Owner will be entitled to rely on the accuracy and completeness of the information furnished by Contractor.

9.4 DECISIONS TO WITHHOLD CERTIFICATION AND PAYMENT

A. Architect may withhold certification of a payment request in whole or in part to the extent reasonably necessary to protect Owner if, in the opinion of Architect, the representations to Owner required by Section 9.3, Paragraph B cannot be accurately made. If

Architect is unable to certify payment in the amount of the payment request, Architect will notify Contractor and Owner as provided in Section 9.3, Paragraph A. If Contractor and Architect cannot agree on a revised amount, Architect will promptly certify a payment request for the amount for which Architect is able to make such representations to Owner. Architect may also decide not to certify payment or, because of subsequently discovered evidence or subsequent observations, may nullify the whole or a part of a payment request previously certified, to such extent as may be necessary in Architect's opinion to protect Owner from loss because of:

1. Defective work not remedied;
2. Third-party claims filed or reasonable evidence indicating probable filing of such claims;
3. Failure of Contractor to make payments properly to Subcontractors for labor, materials, equipment, construction or services;
4. Reasonable evidence that the Work cannot be completed for the unpaid balance of the Contract Sum;
5. Damage to Owner or another contractor for which Contractor is responsible;
6. Reasonable evidence that the Work will not be completed within the Contract Time and that the unpaid balance will not be adequate to cover the cost of completing the Work and damages for the anticipated delay; or
7. Contractor's persistent failure to carry out the Work in accordance with the Contract Documents.

B. Owner reserves the right to withhold payments to Contractor, subsequent to Architect's certification of any payment request, in order to protect Owner from loss due to any condition described in Section 9.4, Paragraph A, Subparagraphs 1 through 7. Upon satisfactory resolution of any such conditions, payments so withheld will be made.

9.5 PROGRESS PAYMENTS

A. Owner will pay Contractor progress payments within the parameters of Section 9.2 within fifteen (15) days after Owner receives the certified payment request from Architect.

B. Owner will make payments to Contractor by either placing the payments in the mail addressed to Contractor or by electronic transfer at Owner's discretion.

C. Upon receipt of any payment from Owner, Contractor will pay to each Subcontractor the amount paid to Contractor on account of such Subcontractor's portion of the Work.

D. Contractor will maintain a copy of each payment request at the Project site for review by the Subcontractors.

E. No payment made under the Contract Documents, either in whole or in part, will be construed to be an acceptance of defective or improper materials or workmanship.

F. In addition and notwithstanding the foregoing, Owner will also withhold and retain 10% of payments made to Contractor.

G. Owner will pay any unpaid retention less any amounts withheld pursuant to Section 9.4 within forty-five (45) days after Contractor achieves Substantial Completion, submits its payment request for retained funds, delivers to the Architect Owner's form entitled "Contractor's Substantial Completion Affidavit and Consent of Surety" fully executed by Contractor and its surety, obtains Waiver and Release documents executed by all subcontractors and suppliers having claim against the retained funds, and Owner receives a certificate of occupancy.

9.6 FINAL PAYMENT

A. Owner will make full and final payment of the Contract Sum within thirty (30) days of the completion of all of the following requirements:

1. Contractor has submitted its final payment request;
2. Architect has declared to Owner in writing that the Work is complete;
3. Contractor has obtained waiver and release upon final payment documents executed by all of the subcontractors performing work and/or providing materials covered by the Contractor's final payment request; and
4. Contractor has collected and provided to Owner all manufacturers' and other guaranties and warranties, properly signed and endorsed to Owner, that are required by the Contract Documents that extend for a period beyond one year after substantial completion. (Delivery of such guaranties and warranties will not relieve Contractor for any obligation assumed under any other provision of the Contract Documents.).

B. Acceptance of final payment by Contractor or any Subcontractor will constitute a waiver of claims by the payee except for those claims previously made in writing pursuant to Section 7 and identified by Contractor in its affidavit as still pending.

C. If the aggregate of previous payments made by Owner exceeds the amount due Contractor, Contractor will reimburse the difference to Owner.

SECTION 10 - PROTECTION OF PERSONS AND PROPERTY

10.1 SAFETY PRECAUTIONS AND PROGRAMS

Contractor will be responsible to Owner for initiating and supervising all safety programs in connection with the performance of the Work.

10.2 SAFETY OF PERSONS AND PROPERTY

A. Contractor will take reasonable precautions to prevent damage, injury, or loss to:

1. All persons on the site;
2. The Work and materials and equipment to be incorporated into the Work; and
3. Other property at the site or adjacent to it.

B. Contractor will give notices and comply with applicable laws, ordinances, rules, regulations, and other lawful requirements of public authorities bearing on the safety or protection of persons and property. No work will be performed that may pose an undue safety hazard to Contractor, Contractor's employees, or any other person.

C. Contractor will designate a responsible member of its organization at the site whose duty will be the prevention of accidents. This person will be Contractor's onsite representative unless otherwise designated in writing by Contractor to Owner and Architect.

10.3 EMERGENCIES

In case of an emergency endangering life or threatening the safety of any person or property, Contractor may, without waiting for specific authorization from Architect or Owner, act at its own discretion to safeguard persons or property. Contractor will immediately notify Architect of such emergency action and make a full written report to Architect within five (5) days after the event.

10.4 HAZARDOUS MATERIALS

In the event the Contractor encounters on the site material reasonably believed to be hazardous materials which have not been rendered harmless, the Contractor shall immediately stop Work in the area affected and report the condition to the Owner and Architect in writing. The Work in the affected area shall be resumed in the absence of hazardous materials, or when it has been rendered harmless, by written agreement of the Owner and Contractor.

SECTION 11 - INSURANCE AND BONDS

11.1 CONTRACTOR'S LIABILITY INSURANCE

A. Contractor will obtain the following insurance and provide evidence thereof as described below prior to commencement of the Work or within ten (10) days after signing the Agreement, whichever is earlier:
   1. Workers Compensation Insurance.
   2. Employers Liability Insurance with minimum limits of the greater of $500,000 E.L. each accident, $500,000 E. L. disease-each employee, $500,000 E.L. disease-policy limit or as required by the law of the state in which the Project is located.

   3. Commercial General Liability Insurance – ISO Form CG 00 01 (12/07) or equivalent Occurrence policy which will provide primary coverage to the additional insureds (the Owner and the Architect) in the event of any Occurrence, Claim, or Suit with:
      a. Limits of the greater of Contractor's actual coverage amounts or the following:
         1) $2,000,000 General Aggregate;
         2) $2,000,000 Products - Comp/Ops Aggregate:
         3) $1,000,000 Personal and Advertising Liability:
         4) $1,000,000 Each Occurrence;
         5) $50,000 Fire Damage to Rented Premises (Each Occurrence).
      b. Endorsements attached to the General Liability policy including the following or their equivalent:
         1) ISO Form CG 25 03 (05/09), Amendment of Limits of Insurance (Designated Project or Premises), describing the Agreement and specifying limits as shown above.
         2) ISO Form CG 20 10 (07/04), Additional Insured -- Owners, Lessees, Or Contractors (Form B), naming Owner and Architect as additional insureds.
   4. Automobile Liability Insurance, with:
      a. Combined Single Limit each accident in the amount of $1,000,000 or Contractor's actual coverage, whichever is greater; and
      b. Coverage applying to "Any Auto."

B. Contractor will provide evidence of such insurance to Owner as follows:
   1. Deliver to Owner a Certificate of Liability Insurance, on ACORD 25 (2010/05) Form, or equivalent:
      a. Listing Owner and its consultants as the Certificate Holders and Additional Insured on the general liability and any excess liability policies;
      b. Attaching the ISO or equivalent endorsements set forth above to the Certificate of Liability Insurance;
      c. Identifying the Project;
      d. Listing the insurance companies providing coverage (All companies listed must be rated in A.M. Best Company Key Rating Guide-Property-Casualty and each company must have a rating of B+ Class VII or better. Companies which are not rated are not acceptable); and
      e. Bearing the name, address and telephone number of the producer and signed by an authorized representative of the producer. The signature may be original, stamped, or electronic.

C. Contractor will maintain, from commencement of the Work, Insurance coverage required herein as follows:
   1. Commercial General Liability Insurance through expiration of warranty period specified in Section 12.2, Paragraph B. including completion of any warranty repairs; and
   2. All other insurance through Final Payment.

D. Owner reserves the right to reject any insurance company, policy, endorsement, or certificate of insurance with or without cause.

E. Owner may, in writing and at its sole discretion, modify the insurance requirements.

F. The cost of insurance as required above will be the obligation of Contractor. Contractor will be responsible for payment of all deductible amounts under all insurance.

G. Owner will provide builders risk insurance for the cost of the Project. The policy will be written on an all risk basis with coverage for perils of wind, flood, earthquake, and terrorism, with exclusions standard for the insurance industry. The policy will be subject to a $5,000 deductible per occurrence which will be the responsibility of Contractor and will not be a reimbursable expense. Owner will provide a copy of the terms and conditions of the builders risk policy to Contractor upon Contractor's request. Contractor will comply with terms, conditions, and deadlines of the builders risk policy. The terms, conditions, and deadlines of the builders risk policy shall govern coverage. In addition, when there is a loss which may be covered by the builders risk insurance policy, Contractor will comply with the following:
   1. Contractor will report the loss immediately to builders risk commercial insurer by calling 1-866-537-7475 and shall make such further written submissions as required and otherwise comply with all requirements of the builders risk policy.
   2. Contractor will report the loss immediately to the Owner.
   3. Contractor will immediately notify its general liability insurance carrier of the loss.
   4. Contractor will take all necessary and appropriate actions to protect the property and individuals from further loss, harm, and injury. In the event there are damages resulting from fire or water, restoration shall be performed only by a certified restoration contractor.
   5. To the extent possible, Contractor will preserve and not disturb the evidence of the loss until after the builders risk commercial insurer and all interested parties and their insurance carriers have had the opportunity to view and investigate the site and loss.
   6. Contractor will cooperate with Owner and the builders risk commercial insurer in the investigation, documentation, and settlement of loss claims, including without limitation promptly responding to all requests for information and documentation from the builders risk commercial insurer and/or Owner.

11.2 PERFORMANCE BOND AND LABOR AND MATERIAL PAYMENT BOND

A. Prior to commencement of the Work or within ten (10) days after signing the Agreement, whichever is earlier, Contractor will furnish to Owner a performance bond and a labor and material payment bond each in an amount equal to one hundred percent (100%) of the Contract Sum as security for all obligations arising under the Contract Documents. Such bonds will:
   1. Be written on Form AIA Document A312 (1984).
   2. Be issued by a surety company or companies licensed in the state in which the Project is located and holding valid certificates of authority under Sections 9304 to 9308, Title 31, of the United States Code as acceptable sureties or reinsurance companies on federal bonds.
   3. Have a penal sum obligation not exceeding the authorization shown in the current revision of Circular #570 as issued by the United States Treasury Department, i.e. "Treasury List".
   4. Be accompanied by a certified copy of the power of attorney stating the authority of the attorney-in-fact executing the bonds on behalf of the surety.

B. Owner reserves the right to reject any surety company, performance bond, or labor and material payment bond with or without cause.

C. The cost of the bonds as required above will be the obligation of Contractor.

SECTION 12 - UNCOVERING AND CORRECTION OF WORK

12.1 UNCOVERING OF WORK

Contractor will notify Architect at least twenty-four (24) hours in advance of performing work that would cover up work or otherwise make it difficult to perform inspections required by the Specifications or by applicable governing authorities. Should any such work be covered without proper notification having been given to Architect, Contractor will uncover that work for inspection at its own expense.

12.2 CORRECTION OF WORK

A. Contractor will promptly correct any portion of the Work that is rejected by Architect or which fails to conform to the requirements of the Contract Documents, whether observed before or after Substantial Completion and whether or not fabricated, installed, or completed. Contractor will bear the cost of correcting such rejected Work, including additional testing and inspection costs, compensation for Architect's services, and any other expenses made necessary thereby.

B. Contractor will remedy any defects due to faulty materials, equipment, or workmanship which appear within a period of one (1) year from the date of Substantial Completion or within such longer period of time as may be prescribed by law or by the terms of any applicable special warranty required by the Contract Documents. Contractor will pay all costs of correcting faulty work, including without limitation additional Architect's fees, attorney fees, expert fees, consultant fees, copy costs, and other expenses when incurred.

C. Nothing in the Contract Documents will be construed to establish a period of limitation within which Owner may enforce the obligation of Contractor to comply with the Contract Documents. The one-year period specified above has no relationship to the time within which compliance with the Contract Documents may be sought to be enforced, nor to the time within which proceedings may be commenced to establish Contractor's liability with respect to Contractor's obligations.

12.3 ACCEPTANCE OF NONCONFORMING WORK

A. If Owner prefers to accept any portion of the Work not in conformance with the Contract Documents, Owner may do so instead of requiring removal and correction of the nonconforming Work. In that event, the Contract Sum will be reduced by an amount agreed upon by the parties that reflects the difference in value to Owner between the Work as specified and the nonconforming Work. Such adjustment may consider increased maintenance costs, early replacement costs, increased inefficiency of use, and the like and will be effective whether or not final payment has been made. Such adjustment will be reflected in a Change Order pursuant to Section 7.5.

B. Temporary or trial usage by Owner or Architect of mechanical devices, machinery, apparatus, equipment, or other work or materials supplied under the Contract Documents prior to written acceptance by Architect, will not constitute Owner's acceptance.

SECTION 13 - RESOLUTION OF DISPUTES

13.1 SUBMITTAL OF DISPUTE

In the event there is any dispute arising under this Agreement which cannot be resolved by agreement between the parties, either party may submit the dispute with all documentation upon which it relies to the Director of Architecture, Engineering, and Construction, Meetinghouse Facilities Department, 50 East North Temple, Salt Lake City, Utah 84150, who will convene a dispute resolution conference within thirty (30) days. The dispute resolution conference will constitute settlement negotiations and any settlement proposal made pursuant to the conference will not be admissible as evidence of liability. In the event that the parties do not resolve their dispute pursuant to the dispute resolution conference, either party may commence legal action to resolve the dispute. Any such action must be commenced within six (6) months from the first day of the dispute resolution conference or be time barred. Submission of the dispute to the Director as outlined above is a condition precedent to the right to commence legal action to resolve any dispute. In the event that either party commences legal action to adjudicate any dispute without first submitting the dispute to the Director, the other party will be entitled to obtain an order dismissing the litigation without prejudice and awarding such other party any costs and attorney fees incurred by that party in obtaining the dismissal, including without limitation copy costs, and expert and consultant fees and expenses.

13.2 CONTRACTOR TO PROCEED WITH DILIGENCE

Pending final resolution of a dispute hereunder, Contractor will proceed diligently with the performance of its obligations under this Agreement.

SECTION 14 - TERMINATION

14.1 TERMINATION BY CONTRACTOR

In the event Owner materially breaches any term of the Contract Documents, Contractor will promptly give Written Notice of the breach to Owner. If Owner fails to cure the breach within ten (10) days of the Written Notice, Contractor may terminate the Agreement by giving Written Notice to Owner and recover from Owner the percentage of the Contract Sum represented by the Work completed on the Project site as of the date of termination together with any out of pocket loss Contractor has sustained with respect to materials and equipment as a result of the termination prior to completion of the Work, less any offsets. Contractor will not be entitled to unearned profits or any other compensation or damages as a result of the termination and hereby waives any claim therefor. Contractor will provide to Owner all warranty, as built, inspection, and other close out documents as well as materials that Contractor has in its possession or control at the time of termination. Without limitation, Contractor's indemnities and obligations under section 3.14 as well as all warranties in the specifications relative to Work provided through the date of termination survive a termination hereunder.

14.2 TERMINATION BY OWNER FOR CAUSE

Should Contractor fail to provide Owner with the bonds and certificates of insurance required by Section 11 within the time specified therein, make a general assignment for the benefit of its creditors, fail to apply enough properly skilled workmen or specified materials to properly prosecute the Work in accordance with Contractor's schedule, or otherwise materially breach any provision of the Contract Documents, then Owner may, without any prejudice to any other right or remedy, give Contractor Written Notice thereof. If Contractor fails to cure its default within ten (10) days, Owner may terminate the Agreement by giving Written Notice to Contractor. In such case, Owner may, in Owner's sole discretion, take legal assignment of subcontracts and other contractual rights of Contractor and/or take possession of the premises and all materials, tools, equipment, and appliances thereon, and finish the Work by whatever method Owner deems expedient. Contractor will not be entitled to receive any further payment until the Work is finished. If the unpaid balance of the Contract Sum exceeds the expense of finishing the Work, including compensation for additional administrative, architectural, consultant, and legal services (including without limitation attorney fees, expert fees, copy costs, and other expenses), such excess will be paid to Contractor. If such expense exceeds the unpaid balance, Contractor will pay the difference to Owner. Contractor will provide to Owner all warranty, as built, inspection, and other close out documents as well as materials that Contractor has in its possession or control at the time of termination. Without limitation, Contractor's indemnities and obligations under section 3.14 as well as all warranties in the specifications relative to Work provided through the date of termination survive a termination hereunder.

14.3 TERMINATION BY OWNER FOR CONVENIENCE

Notwithstanding any other provision contained in the Contract Documents, Owner may, without cause and in its absolute discretion, terminate the Agreement at any time. In the event of such termination, Contractor will be entitled to recover from Owner the

percentage of the Contract Sum equal to the percentage of the Work which Architect determines has been completed on the Project site as of the date of termination together with any out of pocket loss Contractor has sustained with respect to materials and equipment as a result of the termination prior to completion of the Work, less any offsets. Contractor will not be entitled to unearned profits or any other compensation as a result of the termination and hereby waives any claim therefor. Contractor will provide to Owner all warranty, as built, inspection, and other close out documents as well as materials that Contractor has in its possession or control at the time of termination. Owner may, in Owner's sole discretion, take legal assignment of subcontracts and other contractual rights of Contractor. Without limitation, Contractor's indemnities and obligations under section 3.14 as well as all warranties in the specifications relative to Work provided through the date of termination survive a termination hereunder.

SECTION 15 - MISCELLANEOUS PROVISIONS

15.1 GOVERNING LAW

The parties acknowledge that the Contract Documents have substantial connections to the State of Utah. The Contract Documents will be deemed to have been made, executed, and delivered in Salt Lake City, Utah. To the maximum extent permitted by law, (i) the Contract Documents and all matters related to their creation and performance will be governed by and enforced in accordance with the laws of the State of Utah, excluding conflicts of law rules; and (ii) all disputes arising from or related to the Contract Documents will be decided only in a state or federal court located in Salt Lake City, Utah and not in any other court or state. Toward that end, the parties hereby consent to the jurisdiction of the state and federal courts located in Salt Lake City, Utah and waive any other venue to which they might be entitled by virtue of domicile, habitual residence, place of business, or otherwise.

15.2 NO WAIVER

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

15.3 RULE OF CONSTRUCTION

Owner and Contractor agree that the Contract Documents will be deemed to have been drafted by both Owner and Contractor and will not be construed against either Owner or Contractor because of authorship.

15.4 ENFORCEMENT

In the event either party commences legal action to enforce or rescind any provision of the Contract Documents, the prevailing party will be entitled to recover its attorney fees and costs, including without limitation all copy costs and expert and consultant fees and expenses, incurred in that action and on all appeals, from the other party.

15.5 TESTS AND INSPECTIONS

A. Owner and Architect have the right to have tests made when they deem it necessary. Tests conducted by Owner or Architect will be paid for by Owner. Should a test reveal a failure of the Work to meet Contract Document requirements, the cost of the test as well as subsequent tests related to the failure necessary to determine compliance with the Contract Documents will be paid for by Owner, with the cost thereof deducted from the Contract Sum by Modification.

B. Tests will be made in accordance with recognized standards by a competent, independent testing laboratory. Materials found defective or not in conformity with Contract Document requirements will be promptly replaced or repaired at the expense of Contractor.

C. Owner and Architect have the right to obtain samples of materials to be used in the Work and to test samples for determining whether they meet Contract Document requirements. Samples required for testing will be furnished by Contractor and selected as directed by Architect. Samples may be required from the sample's source, point of manufacture, point of delivery, or point of installation at Architect's discretion. Samples not required as a Submittal in the Specifications will be paid for by Owner. Should tests reveal a failure of the Sample to meet the Contract Document requirements, Contractor will provide other Samples that comply with the requirements of the Contract Documents.

END OF DOCUMENT

SUPPLEMENTARY CONDITIONS
FIXED SUM (U.S.)

ITEM 1 - GENERAL

1. Conditions of the Agreement and General Conditions apply to each Division of the Specifications.
2. Provisions contained in Division 01 apply to all Divisions of the Specifications.

ITEM 2 - LIQUIDATED DAMAGE AMOUNTS:

1. The amount of liquidated damages to the benefit of the Contractor for delays under General Conditions Section 7.3, Paragraph B is $400.00 per day.
2. The amount of liquidated damages to be paid to the Owner for delays in Substantial Completion under General Conditions Section 8.3, Paragraph A is $400.00 per day.
3. The amount of liquidated damages to be paid to the Owner for delays in completing work itemized on the Substantial Completion Certificate under General Conditions Section 8.3, Paragraph B is $200.00 per day.

ITEM 3 - PERMITS

1. Delete Section 3.6, Paragraph B of the General Conditions and replace with the following:

B. Contractor will obtain and pay for the building permit and all other permits, governmental fees, licenses and inspections necessary for the proper execution and completion of the Work. The Owner will reimburse the contractor for all permits afterproper receipts and backup has been submitted.

ITEM 4 - MISCELLANEOUS CHANGES IN GENERAL CONDITIONS

1. FOR PROJECTS EXCEEDING $5 MILLION – CONTRACTOR TO PROVIDE BUILDER'S RISK INSURANCE (AND NOT OWNER)

Replace Section 11.1 Contractor's Liability Insurance of the General Conditions with the following:

11.1 CONTRACTOR'S LIABILITY INSURANCE

A. Contractor will obtain the following insurance and provide evidence thereof as described below prior to commencement of the Work or within ten (10) days after signing the Agreement, whichever is earlier:

1. Workers Compensation Insurance.
2. Employers Liability Insurance with minimum limits of the greater of: $500,000 E.L. each accident, $500,000 E. L. disease-each employee, $500,000 E.L. disease-policy limit; or as required by the law of the state in which the Project is located.
3. Commercial General Liability Insurance – ISO Form CG 00 01 (12/07) or equivalent Occurrence policy which will provide primary coverage to the additional insureds (the Owner and the Architect) in the event of any Occurrence, Claim, or Suit with:

a. Limits of the greater of: Contractor's actual coverage amounts or the following:

1) $2,000,000 General Aggregate;

2) $2,000,000 Products - Comp/Ops Aggregate:

3) $1,000,000 Personal and Advertising Injury:

4) $1,000,000 Each Occurrence;

5) $50,000 Damage to Rented Premises.

b. Endorsements attached to the General Liability policy including the following or their equivalent:

1) ISO Form CG 25 03 (05/09), Designated Construction Project(s) General Aggregate Limit, describing the project and specifying that limits apply to each project of the contractor.

2) ISO Form CG 20 10 (07/04), Additional Insured – Owners, Lessees or Contractors – Scheduled Person or Organization, naming Owner and Architect as additional insureds.

4. Automobile Liability Insurance, with:

a. Combined Single Limit each accident in the amount of $1,000,000 or Contractor's actual coverage, whichever is greater; and

b. Coverage applying to "Any Auto" or equivalent to all owned autos, hired autos, and non-owned autos.

5. Builder's Risk Insurance Policy – ISO Form CP 00 20 (10/12), Builders Risk Coverage (or equivalent form) and ISO Form CP 10 30 (10/12) Causes of Loss – Special Form, and ISO Form CP 11 20 (06/07) Builders Risk – Collapse During Construction (or equivalent form) with Limits of Insurance in the amount of the Contract Sum.

a. Policy will cover materials stored at temporary storage locations and materials in transit.

b. Include Owner and Subcontractors as additional insureds.

c. Policy will be subject to a deductible of not less than $5,000 per occurrence which will be the responsibility of Contractor and will not be included in the Cost of the Work or be a reimbursable expense.

B. Contractor will provide evidence of such insurance to Owner as follows:

1. Deliver to Owner a Certificate of Insurance on ACORD 25 (2010/05) or equivalent:

a. Listing Owner as the Certificate Holder and Owner and Architect as Additional Insureds on general liability and any excess liability policies;

b. Attaching the endorsements set forth above for additional insured on general liability (CG 20 10 07/04) and Designated Construction Project Aggregate Limit (CG 25 03 05/09).

c. Identifying the Project.

d. Listing the insurance companies providing coverage. All companies must be rated in A.M. Best Company's Key Rating Guide – Property-Casualty, current edition, at a rating B+ Class VII or better. Companies that are not rated are not acceptable.

e. Bearing the name, address, and telephone number of the producer and signed by an authorized representative of the producer. The signature may be original, stamped, or electronic. A faxed or digital copy is also acceptable.

2. Deliver to Owner a Certificate of Insurance on ACORD 27, Evidence of Property

Insurance, for the Builders Risk Insurance Policy attaching the endorsement giving evidence that the Owner and all Subcontractors are listed as additional insureds on the Builders Risk Policy.

C. Contractor will maintain, from commencement of the Work, Insurance coverage required herein as follows:

1. Commercial General Liability Insurance through expiration of warranty period specified in Section 12.2, Paragraph B. including completion of any warranty repairs;
2. Builders' Risk Insurance through Substantial Completion; and
3. All other insurance through final payment.

D. In the event of a loss, or upon request by Owner, Contractor will provide Owner with a copy of required insurance policies above.

E. Owner reserves the right to reject any insurance company, policy, endorsement, or certificate of insurance with or without cause.

F. Owner may, in writing and at its sole discretion, modify the insurance requirements.

ITEM 5 - STATE OF UTAH SPECIFIC SUPPLEMENTARY CONDITIONS

RETENTION APPLIED TO CONTRACTOR PAYMENTS FOR PROJECTS IN UTAH:

Replace section 9.5.F of the General Conditions with the following:

F. In addition and notwithstanding the foregoing, Owner may also withhold and retain 5% of payments made to Contractor. These retention funds will be held in an interest bearing account.

PAYMENT OF RETAINED FUNDS IN UTAH:

Replace section 9.5 G of the General Conditions with the following:

G. After Contractor achieves Substantial Completion and submits its payment request for retained funds and delivers to the Architect Owner's form entitled "Contractor's Substantial Completion Affidavit and Consent of Surety" fully executed by Contractor and its surety, if any, and provides statutory Conditional Waiver and Release documents executed by all subcontractors and suppliers having claim against the retained funds, Owner will pay any unpaid retention less any amounts withheld pursuant to Section 9.4 within forty-five (45) days from the later of (a) the date Owner received Contractor's payment request for retained funds and fully executed Contractor's Substantial Completion Affidavit and Consent of Surety, (b) the date a certificate of occupancy is issued; (c) the date that a building inspector having authority to issue its own certificate of occupancy does not issue that certificate but permits occupancy.

UTAH STATE SALES TAX:

Add the following to the General Conditions:

1. Contractors should be exempt on purchases of material installed or converted into real property to be used by the Owner. The Contractor will furnish each vendor with a completed Exemption Certificate Form TC-721. The certificate will be prepared by

the Contractor for each vendor in order to obtain the exemption.

2. The Owner's tax exempt number is 11871701-002-STC.

UTAH NOTICE OF INTENT TO OBTAIN FINAL COMPLETION:

Add the following to the General Conditions:

A. Contractor will file with the State Construction Registry, on its own behalf and/or on behalf of Owner, a notice of intent to obtain final completion at least 45 days before the day on which the Owner or Contractor files or could file a notice of completion under Utah Code Ann. Section 38-1a-506 if:

1. The completion of performance time under the original contract for construction work is greater than 120 days;

2. The total original construction contract price exceeds $500,000; and

3. The original contractor or owner has not obtained a payment bond in accordance with Utah Code Ann. Section 14-2-1.

UTAH NOTICE OF COMPLETION:

Add the following to the General Conditions:

A. Within five (5) calendar days of final completion of the Project and in compliance with Section 38-1a-507 Utah Code Annotated, Contractor will file with the State Construction Registry, and copy to Owner, a notice of completion which will include, without limitation, the following:

1. The name, address, telephone number, and email address of the person filing the notice of completion;

2. The name of the county in which the Project and/or Project site is located;

3. The date on which final completion is alleged to have occurred;

4. The method used to determine final completion; and

5. One of the following:

a. The tax parcel identification number of each parcel included in the Project and/or Project site;

b. The entry number of a preliminary notice on the same project that includes the tax parcel identification number of each parcel included in the Project and/or Project site; or

c. The entry number of the building permit issued for the Project.

B. Notwithstanding any other provision of the Contract Documents to the contrary, Contractor and Owner agree that any breach or failure to comply with this Section by the Contractor will constitute a breach of contract and the Contractor will be liable for any direct, indirect, or consequential damages to the Owner flowing from this breach.

UTAH PROGRESS PAYMENTS AND FINAL PAYMENT:

Replace Section 9.5.A of the General Conditions with the following:

9.5 PROGRESS PAYMENTS

A. Owner will pay Contractor progress payments within the parameters of Section 9.2 within fifteen (15) days after:

1. Contractor has submitted a progress payment request;
2. Contractor has obtained Conditional Waiver and Release Upon Progress Payment documents (in content complying with Utah Code § 38-1a-802) executed by each of the subcontractors performing work and/or providing materials covered by the Contractor's progress payment request; and
3. Owner receives the certified payment request from Architect.

Replace Section 9.6.A.3 of the General Conditions with the following:

9.6 FINAL PAYMENT

3. Contractor has obtained Waiver and Release Upon Final Payment documents (in content complying with Utah Code § 38-1a-802) executed by each of the subcontractors performing work and/or providing materials covered by the Contractor's final payment request;

END OF DOCUMENT

SECTION 01 1000 - SUMMARY

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Project information.
2. Work covered by Contract Documents.
3. Owner-furnished/Contractor-installed (OFCI) products
4. Owner-furnished/Owner-installed (OFOI) products.
5. Contractor's use of site and premises.
6. Work restrictions.

B. Related Requirements:

1. Section 01 5000 "Temporary Facilities and Controls" for limitations and procedures governing temporary use of Owner's facilities.

1.2 PROJECT INFORMATION

A. Project Identification: Logan UT Seminary Building.

1. Project Location: 110 W. 100 S.; Logan, Utah 84321.
2. FFKR Project Number: 24003.

B. Owner: The Church of Jesus Christ of Latter Day Saints.

C. Architect: FFKR Architects, 730 Pacific Avenue, Salt Lake City, Utah 84104, (801) 521-6186.

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

1. Civil Engineer: Civil Science.
2. Landscape Architecture: FFKR Architects.
3. Structural Engineer: ARW Engineering.
4. Plumbing: Heath Engineering.
5. Mechanical Engineer: Heath Engineering.
6. Electrical Engineer: Heath Engineering.

E. Web-Based Project Software: Project software will be used for purposes of managing communication and documents during the construction stage.

1. See Section 01 3100 "Project Management and Coordination." for requirements for using web-based Project software.

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:

1. Demolition of existing building and replacement with new single-story Seminary Building, accommodating three classrooms, office space, breakroom, and other Work indicated in the Contract Documents.

B. Type of Contract:

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

1.4 OWNER-FURNISHED/CONTRACTOR-INSTALLED (OFCI) PRODUCTS

A. Owner's Responsibilities: Owner will furnish products indicated and perform the following, as applicable:

1. Provide to Contractor Owner-reviewed Product Data, Shop Drawings, and Samples.
2. Provide for delivery of Owner-furnished products to Project site.
3. Upon delivery, inspect, with Contractor present, delivered items.

    a. If Owner-furnished products are damaged, defective, or missing, arrange for replacement.

4. Obtain manufacturer's inspections, service, and warranties.
5. Inform Contractor of earliest available delivery date for Owner-furnished products.

B. Contractor's Responsibilities: The Work includes the following, as applicable:

1. Designate delivery dates of Owner-furnished products in Contractor's construction schedule, utilizing Owner-furnished earliest available delivery dates.
2. Review Owner-reviewed Product Data, Shop Drawings, and Samples, noting discrepancies and other issues in providing for Owner-furnished products in the Work.
3. Receive, unload, handle, store, protect, and install Owner-furnished products.
4. Make building services connections for Owner-furnished products.
5. Protect Owner-furnished products from damage during storage, handling, and installation and prior to Substantial Completion.
6. Repair or replace Owner-furnished products damaged following receipt.

C. Owner-Furnished/Contractor-Installed (OFCI) Products:

1. Fixed writeable walls as specified in Section 10 1100 "Visual Display Units".
2. Interior signage as specified in Section 10 1400 "Signage".
3. Residential appliances as specified in Section 11 3013 "Residential Appliances".
4. Network Streaming Equipment.

1.5 OWNER-FURNISHED/OWNER-INSTALLED (OFOI) PRODUCTS

A. The Owner will furnish and install products indicated.

B. Owner-Furnished/Owner-Installed (OFOI) Products:

1. High security cylinders and cores.
2. Selected commercial toilet accessories.
3. Carpet and carpet base.

1.6 CONTRACTOR'S USE OF SITE AND PREMISES

A. Unrestricted Use of Site: Contractor shall have full use of Project site for construction operations during construction period. Contractor's use of Project site is limited only by Owner's right to perform work or to retain other contractors on portions of Project.

B. 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.

1.7 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.
2. Conform to city and county work hour and noise ordinances and restrictions.

B. On-Site Work Hours: Limit work in the existing building to normal business working hours as approved by Owner, Monday through Saturday, unless otherwise indicated.

1. Weekend Hours: Sunday work is not permitted, except for life safety issues or cause of major damages to the project. Sunday work to improve scheduling and project performance is not allowed.

C. Controlled Substances: Use of tobacco or vaping products and other controlled substances on Project site is not permitted.

1. Smoking, vaping, consumption of alcohol, tobacco use in any form, use of illegal drugs, or use of any other controlled, non-medically prescribed substance is not allowed on the Project. Do not allow persons under influence of illegal drugs or alcohol on the Project site.

a. Smoking or vaping is allowed only in areas specifically designated by the Owner and the General Contractor.
b. Smoking is not permitted anywhere where smoke could enter building through entrances or outdoor-air intakes.

D. Employee Identification: Provide identification tags for Contractor personnel working on Project site. Require personnel to use identification tags at all times.

E. Employee Screening: Comply with Owner's requirements for drug and background screening of Contractor personnel working on Project site.

1. Maintain list of approved screened personnel with Owner's representative.
2. Ensure that workers are legally employed.

F. The following requirements apply on the Project Site and while performing Work:

1. Do not allow profanity, discourteous behavior, or uncivil behavior to others.
2. Do not allow pornographic or other indecent materials on site.
3. Require workers to wear shirts with sleeves, shoes, and to refrain from wearing immodest, offensive, or inappropriate clothing, while on Project Site. Do not allow tank tops, shorts, open-toed shoes, and hats (other than hardhats) to be worn on the project site.
4. Do not allow obnoxious or loud music on Project Site. Do not allow playing of any music within existing facilities.
5. Do not build fires on Project Site.
6. Do not allow weapons on Project Site, except those carried by law enforcement officers or other uniformed security personnel who have been retained by Owner or Contractor to provide security services.
7. Allow eating only in areas specifically designated by the Owner and the General Contractor. Do not allow food or drink in Project Building, except water.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION 01 1000

SECTION 01 2500 - SUBSTITUTION PROCEDURES

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes administrative and procedural requirements for substitutions.

B. Related Requirements:

1. Section 01 6000 "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 Owner’s form, “Equal Product Approval Request Form” in the Owners bidding requirements included in these specifications.
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.
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 of 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: Not allowed.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION 01 2500

SECTION 01 2600 - 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 01 2500 "Substitution Procedures" for administrative procedures for handling requests for substitutions made after the Contract award.

1.2 INSTRUCTION BULLETINS (IB)

A. Instruction Bulletin (IB): Four-part document that facilitates Architect’s issuing of the following:

1. Architect’s Supplemental Instructions (ASI)
2. Request for Proposals (RFP)
3. Field Change Directives (FCD).
4. Construction Change Directives (CCD).

B. IBs will be issued to Owner and Contractor using Architect’s Project Management System (Newforma).

1. IB status will be reviewed as a priority at weekly construction meetings.

1.3 ARCHITECTS SUPPLEMENTAL INSTRUCTIONS (ASI)

A. Architect will issue supplemental instructions authorizing Minor Changes in the Work, not involving adjustment to the Contract Sum or the Contract Time, on AIA Document G710, "Architect's Supplemental Instructions."

1. An ASI is an instruction or additional information, consistent with the intent of the contract documents, to perform the work described.

1.4 REQUEST FOR PROPOSAL (RFP)

A. Request for Proposal (RFP): Request to Contractor to provide cost to perform new or modified Work described. RFP may or may not result in a change to contract price or schedule. (Also called “Proposal Request”.)

B. Proposal Request Form: Use Form provided by Owner.

C. Owner-Initiated RFPs: 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, description will include supplemental or revised Drawings and Specifications.

1. Proposal Requests issued by Architect are for information only. Do not consider them instructions either to stop work in progress or to execute the proposed change.
2. Within time specified in Proposal Request after receipt of Proposal Request (or within 10 days if time is not indicated), 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.

D. Contractor-Initiated RFPs: If latent or unforeseen conditions require modifications to the Contract, Contractor may propose changes by submitting a request for a change to Architect.

1. Change Order Request (COR): Contractor-initiated proposal request.

    a. Issue CORs on the form approved by Owner.
    b. Issue CORs to Architect for review and to Owner for review and approval. Owner will transmit the approved COR to Architect for preparation of the Change Order.

2. Include 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.
3. 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.
4. Indicate applicable taxes, delivery charges, equipment rental, and amounts of trade discounts.
5. Include costs of labor and supervision directly attributable to the change.
6. 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.
7. Comply with requirements in Section 01 6000 "Product Requirements" if proposed change requires substitution of one product or system for product or system specified.

1.5 FIELD CHANGE DIRECTIVES (FCD)

A. Field Change Directives (FCD): Instruction, consistent with intent of Contract Documents, to perform the work described in field. A FCD may or may not result in a change to the contract price.

B. FCDs will be issued to Owner and Contractor.

1.6 CONSTRUCTION CHANGE DIRECTIVE (CCD)

A. Construction Change Directive CCD: Instruction given to Contractor to modify or perform new work described. CCD action is used when the condition or issue requires immediate response and action as not to delay or further impact the cost or schedule for the Work. A CCD will result in a change to the contract price, the schedule, or both.

B. When approved by Owner's representative, Architect will issue Construction Change Directive on form provided by Owner.

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.

C. CCDs will be transmitted by the Architect to Owner for review or approval and subsequently to Contractor for action. The Contractor will respond within 5 days, unless indicated otherwise, with appropriate action and return a cost proposal to Owner for approval. Owner will return approved cost proposal to Architect.

1. Change Order will be generated by Architect, approved by the Owner, and transmitted to the Contractor by the Architect.

D. 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.

1.7 CHANGE ORDER PROCEDURES (CO)

A. On Owner's approval, Architect will issue a Change Order for signatures of Owner, Architect, and Contractor on form provided by Owner.

1. A change order may be generated on Owner's approval of any of following:

a. Request for Proposal (RFP)
b. Field Change Directive (FCD)
c. Construction Change Directive (CCD)
d. Change Order Request (COR).

2. Changes indicated on Contract Documents that were not indicated in original Contract Documents are not approved and are not an acceptable change to the Project unless clouded and indicated in red.
3. Change orders will be generated on a form approved by Owner and issued by Architect. Change orders will require the following in the order indicated:

    a. Review signature of the Architect
    b. Acceptance signature of the Contractor.
    c. Approval signature of Owner.

4. Change order status will be reviewed as a priority at the weekly construction meetings.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION 01 2600

SECTION 01 2900 - 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 012600 "Contract Modification Procedures" for administrative procedures for handling changes to the Contract.
2. 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.

1. Coordinate line items in the schedule of values with items required to be indicated as separate activities in Contractor's construction schedule.

a. Application for Payment forms with continuation sheets.
b. Submittal schedule.
c. 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. Apparent low-bidder shall submit Schedule of Values within 24 hours of notification, using Owner’s Schedule of Values Form.

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. Name of Architect.
c. Architect's Project number.
d. Contractor's name and address.
e. Date of submittal.

2. Arrange the schedule of values in tabular form, with separate columns to indicate the following 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.

3. Provide a breakdown of the Contract Sum in enough detail to facilitate continued evaluation of Applications for Payment and progress reports. Coordinate with Project Manual table of contents. Provide multiple line items for principal subcontract amounts in excess of five percent of the Contract Sum.

a. 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.

4. Round amounts to nearest whole dollar; total shall equal 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. If required, include evidence of insurance.

6. Provide separate line items in the schedule of values for initial cost of materials, for each subsequent stage of completion, and for total installed value of that part of the Work.
7. Each item in the schedule of values and Applications for Payment shall be complete. Include total cost and proportionate share of general overhead and profit for each item.

a. Temporary facilities and other major cost items that are not direct cost of actual work-in-place may be shown either as separate line items in the schedule of values or distributed as general overhead expense, at Contractor's option.

8. Schedule Updating: Update and resubmit the schedule of values before the next Applications for Payment when Change Orders or Construction Change Directives result in a change in the Contract Sum.

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.

1. Initial Application for Payment, Application for Payment at time of Substantial Completion, and final Application for Payment involve additional requirements.

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 G703 and AIA Document G732 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 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 three 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 subcontractors, sub-subcontractors, and suppliers for construction period covered by the previous application.

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. Products list (preliminary if not final).
5. Schedule of unit prices.
6. Submittal schedule (preliminary if not final).
7. List of Contractor's staff assignments.
8. List of Contractor's principal consultants.
9. Copies of building permits.
10. Copies of authorizations and licenses from authorities having jurisdiction for performance of the Work.
11. Initial progress report.
12. Report of preconstruction conference.
13. Certificates of insurance and insurance policies.
14. Performance and payment bonds.
15. 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 01 7700 "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 2900

SECTION 01 3100 - PROJECT MANAGEMENT AND COORDINATION

PART 1 - GENERAL

1.1 SUMMARY

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

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

B. Assure that each contractor participates in coordination requirements. Certain areas of responsibility are assigned to a specific contractor.

C. Related Requirements:

1. Section 01 3200 "Construction Progress Documentation" for preparing and submitting Contractor's construction schedule.
2. Section 01 7300 "Execution" for procedures for coordinating general installation and field-engineering services, including establishment of benchmarks and control points.
3. Section 01 7700 "Closeout Procedures" for coordinating closeout of the Contract.

1.2 DEFINITIONS

A. 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, and in prominent location in 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.

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 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:

1. Project name.
2. Name of Architect.
3. Architect's Project number.
4. Date.
5. Name of Contractor.
6. RFI number, numbered sequentially.
7. RFI subject.
8. Specification Section number and title and related paragraphs, as appropriate.
9. Drawing number and detail references, as appropriate.
10. Field dimensions and conditions, as appropriate.
11. Contractor's suggested resolution. If Contractor's suggested resolution impacts the Contract Time or the Contract Sum, Contractor shall state impact in the RFI.
12. Contractor's signature.
13. 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: AIA Document G716 or software-generated form with substantially the same content as indicated above, acceptable to Architect.

1. Attachments shall be electronic files in PDF format.

D. Architect's 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 01 2600 "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. Software log with not less than 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.

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.

1.6 DIGITAL PROJECT MANAGEMENT PROCEDURES

A. Use of Architect's Digital Data Files: Digital data files of Architect's 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. Contractor shall execute a data licensing agreement in the form of Agreement form acceptable to Owner and Architect.

    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 acceptable to Owner and Architect.

4. The following digital data files will be furnished for each appropriate discipline:

    a. Floor plans.
    b. Reflected ceiling plans.

B. 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.

1.7 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 10 working 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. Preparation of Record Documents.
    o. Use of the premises.
    p. Work restrictions.
    q. Working hours.
    r. Owner's occupancy requirements.
    s. Responsibility for temporary facilities and controls.

t. Procedures for moisture and mold control.
u. Procedures for disruptions and shutdowns.
v. Construction waste management and recycling.
w. Parking availability.
x. Office, work, and storage areas.
y. Equipment deliveries and priorities.
z. First aid.
aa. Security.
bb. 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. Review of mockups.
i. Possible conflicts.
j. Compatibility requirements.
k. Time schedules.
l. Weather limitations.
m. Manufacturer's written instructions.
n. Warranty requirements.
o. Compatibility of materials.
p. Acceptability of substrates.
q. Temporary facilities and controls.
r. Space and access limitations.
s. Regulations of authorities having jurisdiction.
t. Testing and inspecting requirements.
u. Installation procedures.
v. Coordination with other work.
w. Required performance results.
x. Protection of adjacent work.
y. Protection of construction and personnel.

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. 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 preparing operations and maintenance data.
    f. Requirements for delivery of material samples, attic stock, and spare parts.
    g. Requirements for demonstration and training.
    h. Preparation of Contractor's punch list.
    i. Procedures for processing Applications for Payment at Substantial Completion and for final payment.
    j. Submittal procedures.
    k. Owner's partial occupancy requirements.
    l. Installation of Owner's furniture, fixtures, and equipment.
    m. Responsibility for removing temporary facilities and controls.

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

E. Progress Meetings: Conduct progress meetings at weekly 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.

    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) Status of submittals.
        4) Deliveries.
        5) Off-site fabrication.
        6) Access.
        7) Site use.
        8) Temporary facilities and controls.
        9) Progress cleaning.
        10) Quality and work standards.
        11) Status of correction of deficient items.
        12) Field observations.
        13) Status of RFIs.
        14) Status of Proposal Requests.
        15) Pending changes.
        16) Status of Change Orders.
        17) Pending claims and disputes.
        18) 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.

F. Coordination Meetings: Conduct Owner Architect Contractor (OAC) Project coordination meetings at weekly 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. Prior to first coordination meeting, submit list of topics to be discussed at meeting for Owner’s review and comment. Thereafter, forward to Owner and Architect an agenda of each meeting prior to the meeting, and invite them to attend portions of the meeting appropriate to their responsibilities on the project.
    b. 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.
    c. 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.
    d. Review present and future needs of each contractor present, including the following:

        1) Interface requirements.
        2) Sequence of operations.
        3) Status of submittals.
        4) Deliveries.
        5) Off-site fabrication.
        6) Access.
        7) Site utilization.
        8) Temporary facilities and controls.
        9) Work hours.
        10) Hazards and risks.
        11) Progress cleaning.
        12) Quality and work standards.
        13) Change Orders.

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

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION 01 3100

SECTION 01 3200 - 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. Contractor's Construction Schedule.
2. Construction schedule updating reports.
3. Daily construction reports.
4. Material location reports.
5. Site condition reports.
6. Unusual event reports.

B. Related Requirements:

1. Section 01 4000 "Quality Requirements" for schedule of tests and inspections.
2. Section 01 2900 "Payment Procedures" for schedule of values and requirements for use of cost-loaded schedule for Applications for Payment.

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. 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.

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

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

E. 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.

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

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. 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.

C. CPM Reports: Concurrent with CPM schedule, submit each of the following reports. Format for each activity in reports shall 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.

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

E. Daily Construction Reports: Submit at weekly intervals.

F. Material Location Reports: Submit at weekly intervals.

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

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

I. Qualification Data: For scheduling consultant.

1.4 QUALITY ASSURANCE

A. Prescheduling Conference: Conduct conference at Project site to comply with requirements in Section 01 3100 "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 personnel needed to develop and update schedule.
3. Discuss constraints, including work stages, interim milestones, and partial Owner occupancy.
4. Review delivery dates for Owner-furnished products.
5. Review submittal requirements and procedures.
6. Review time required for review of submittals and resubmittals.
7. Review requirements for tests and inspections by independent testing and inspecting agencies.
8. Review time required for Project closeout and Owner startup procedures.
9. Review and finalize list of construction activities to be included in schedule.
10. Review procedures for updating schedule.

1.5 COORDINATION

A. Coordinate Contractor's Construction Schedule with the schedule of values, list of subcontracts, 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 has been developed specifically to manage construction schedules.

B. Scheduling Consultant: Engage a consultant to provide planning, evaluation, and reporting, using CPM scheduling.

1. In-House Option: Owner may waive requirement to retain a consultant if Contractor employs skilled personnel with experience in CPM scheduling and reporting techniques. Submit qualifications.
2. Meetings: Scheduling consultant shall attend all meetings related to Project progress, alleged delays, and time impact.

C. Time Frame: Extend schedule from date established for commencement of the Work to date of Final Completion.

1. Contract completion date shall not be changed by submission of a schedule that shows an early completion date, unless specifically authorized by Change Order.

D. 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 01 3300 "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. 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.
7. Punch List and Final Completion: Include not more than 30 days for completion of punch list items and Final Completion.

E. 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. Products Ordered in Advance: Include a separate activity for each product. Include delivery date indicated in Section 01 1000 "Summary." Delivery dates indicated stipulate the earliest possible delivery date.
2. Work by Owner: Include a separate activity for each portion of the Work performed by Owner.
3. Owner-Furnished Products: Include a separate activity for each product. Include delivery date indicated in Section 01 1000 "Summary." Delivery dates indicated stipulate the earliest possible delivery date.
4. 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.

F. Milestones: Include milestones indicated in the Contract Documents in schedule, including, but not limited to, the Notice to Proceed, Substantial Completion, and Final Completion, and the following interim milestones:

1. Temporary enclosure and space conditioning.

G. 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 01 2900 "Payment Procedures" for cost reporting and payment procedures.

H. 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.

I. 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 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.

J. 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.

K. 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 CPM SCHEDULE REQUIREMENTS

A. 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 commencement of the Work.

a. Failure to include any work item required for performance of this Contract shall not excuse Contractor from completing all work within applicable completion dates.

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.

B. 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. Punch list and Final Completion.
k. Activities occurring following Final Completion.

2. Critical Path Activities: Identify critical path activities, including those for interim completion dates. Scheduled start and completion dates shall 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.

C. 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.

D. 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.
10. Dollar value of activity (coordinated with the schedule of values).

E. 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.

F. 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.

1.8 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 shall 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.

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 3200

SECTION 01 3233 - PHOTOGRAPHIC DOCUMENTATION

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes administrative and procedural requirements for the following:

1. Concealed Work photographs.
2. Periodic construction photographs.
3. Final Completion construction photographs.

B. Related Requirements:

1. Section 01 7700 "Closeout Procedures" for submitting photographic documentation as Project Record Documents at Project closeout.
2. Section 01 7900 "Demonstration and Training" for submitting video recordings of demonstration of equipment and training of Owner's personnel.

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.

1.3 QUALITY ASSURANCE

A. Photographer Qualifications: Engage an adequate photographer to take construction photographs.

1.4 FORMATS AND MEDIA

A. Digital Photographs: Provide color images in JPG format, produced by a digital camera with minimum sensor size of 12 megapixels, and at an image resolution of not less than 3200 by 2400 pixels, and with vibration-reduction technology. Use flash in low light levels or backlit conditions.

B. Digital Images: Submit digital media as originally recorded in the digital camera, without alteration, manipulation, editing, or modifications using image-editing software.

C. Metadata: Record accurate date and time and GPS location data from camera.

D. File Names: Name media files with date and sequential numbering suffix.

1.5 CONSTRUCTION PHOTOGRAPHS

A. Photographer: Engage an acceptable 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. 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.

D. Periodic Construction Photographs: Take 20 photographs weekly. Select vantage points to show status of construction and progress since last photographs were taken.

E. 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.

F. Additional Photographs: Architect may request photographs in addition to periodic photographs specified. Additional photographs will be paid for by Change Order and are not included in the Contract Sum.

1. Three days' notice will be given, where feasible.
2. In emergency situations, take additional photographs within 24 hours of request.
3. Circumstances that could require additional photographs include, but are not limited to, the following:

a. Special events planned at Project site.

b. Immediate follow-up when on-site events result in construction damage or losses.
c. Photographs to be taken at fabrication locations away from Project site. These photographs are not subject to unit prices or unit-cost allowances.
d. Substantial Completion of a major phase or component of the Work.
e. Extra record photographs at time of final acceptance.
f. Owner's request for special publicity photographs.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION 01 3233

SECTION 01 3300 - 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 01 2900 "Payment Procedures" for submitting Applications for Payment and the schedule of values.
2. Section 01 3100 "Project Management and Coordination" for submitting coordination drawings and subcontract list and for requirements for web-based Project software.
3. Section 01 3200 "Construction Progress Documentation" for submitting schedules and reports, including Contractor's construction schedule.
4. Section 01 3233 "Photographic Documentation" for submitting preconstruction photographs, periodic construction photographs, and Final Completion construction photographs.
5. Section 01 4000 "Quality Requirements" for submitting test and inspection reports, and schedule of tests and inspections.
6. Section 01 7700 "Closeout Procedures" for submitting closeout submittals and maintenance material submittals.
7. Section 01 7823 "Operation and Maintenance Data" for submitting operation and maintenance manuals.
8. Section 01 7839 "Project Record Documents" for submitting record Drawings, record Specifications, and record Product Data.
9. Section 01 7900 "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.

    a. Submit sworn statement that lists names of each subcontractor with actual amount of each contract.

2. Submittal Schedule: Submit concurrently with the first complete submittal of Contractor's construction schedule.

    a. Submit revised submittal schedule as required to reflect changes in current status and timing for submittals.

3. 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. Subcontractor preparing the submittal.
    f. Description of the Work covered.
    g. Scheduled date for Architect's final release or approval.
    h. Scheduled dates for purchasing.
    i. Scheduled date of fabrication.
    j. Scheduled dates for installation.
    k. 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 Contractor.
5. Name of firm or entity that prepared submittal.
6. Names of subcontractor, manufacturer, and supplier.
7. Unique submittal number, including revision identifier. Include Specification Section number with sequential alphanumeric identifier and alphanumeric suffix for resubmittals.
8. Category and type of submittal.
9. Submittal purpose and description.

10. Number and title of Specification Section, with paragraph number and generic name for each of multiple items.
11. Drawing number and detail references, as appropriate.
12. Indication of full or partial submittal.
13. Location(s) where product is to be installed, as appropriate.
14. Other necessary identification.
15. Remarks.
16. 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 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.
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. 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.

6. 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.

7. 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 three sets of Samples. Architect will retain two 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.

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 and three 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.

1.9 ARCHITECT'S REVIEW

A. Action Submittals: Architect will review each submittal, indicate corrections or revisions required, and return where required by Contract Documents.

1. PDF Submittals: Architect will indicate, via markup on each submittal, the appropriate action, as follows:

1) "No Exceptions": Architect has no exceptions to submittal.
2) "Revise and Resubmit": Architect requires submittal to be revised and resubmitted.
3) Provide as Noted: Architect has no exceptions to submittal as revised by Architect's notes indicated on submittal.
4) "Returned Without Action": Architect returns submittal without action because submittal was not required by the Contract Documents.

2. Submittals by Web-Based Project Management Software: Architect will indicate, on Project management software website, the appropriate action.

a. Actions taken by indication on Project management software website have the following meanings:

1) "No Exceptions": Architect has no exceptions to submittal.
2) "Revise and Resubmit": Architect requires submittal to be revised and resubmitted.
3) Provide as Noted: Architect has no exceptions to submittal as revised by Architect's notes indicated on submittal.
4) "Returned Without Action": Architect returns submittal without action because submittal was not required by the Contract Documents.

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 return without review, or 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 3300

SECTION 01 4000 - 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 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: Full-size physical assemblies that are constructed either as freestanding temporary built elements or as part of permanent construction. Mockups are constructed to verify selections made under Sample submittals; to demonstrate aesthetic effects and qualities of materials and execution; to review coordination, testing, or operation; to show interface between dissimilar materials; and to demonstrate compliance with specified installation tolerances.

Mockups are not Samples. Unless otherwise indicated, approved mockups establish the standard by which the Work will be judged.

1. Laboratory Mockups: Full-size physical assemblies constructed and tested at testing facility to verify performance characteristics.
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) according to 29 CFR 1910.7, by a testing agency accredited according to NIST's 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" shall have 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 shall be the minimum provided or performed. The actual installation may comply exactly with the minimum quantity or quality specified, or it may exceed the minimum within reasonable limits. To comply with these requirements, indicated numeric values are minimum or maximum, as appropriate, for the context of requirements. Refer uncertainties to Architect for a decision before proceeding.

1.5 INFORMATIONAL SUBMITTALS

A. Contractor's Quality-Control Plan: For quality-assurance and quality-control activities and responsibilities.

B. Qualification Data: For Contractor's quality-control personnel.

C. 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.

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

E. 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.

F. Reports: Prepare and submit certified written reports and documents as specified.

G. 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 to Proceed, 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.

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:

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 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 shall be performed by entities who are recognized experts in those operations. Specialists shall satisfy qualification requirements indicated and shall be engaged in the activities indicated.

1. Requirements of authorities having jurisdiction shall 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 Contractor's responsibilities, including the following:

1. Provide test specimens representative of proposed products and construction.
2. Submit specimens in a timely manner with sufficient time for testing and analyzing results to prevent delaying the Work.
3. Provide sizes and configurations of test assemblies, mockups, and laboratory mockups to adequately demonstrate capability of products to comply with performance requirements.
4. Build site-assembled test assemblies and mockups, using installers who will perform same tasks for Project.
5. Build laboratory mockups at testing facility, using personnel, products, and methods of construction indicated for the completed Work.
6. When testing is complete, remove test specimens and test assemblies, and mockups, and laboratory mockups; do not reuse products on Project.
7. 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 in location indicated or, if not indicated, as directed by Architect.
2. Notify Architect seven days in advance of dates and times when mockups will be constructed.
3. Employ supervisory personnel who will oversee mockup construction. Employ workers who will be employed to perform same tasks during the construction at Project.
4. Demonstrate the proposed range of aesthetic effects and workmanship.
5. 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.

6. Promptly correct unsatisfactory conditions noted by Architect's preliminary review, to the satisfaction of the Architect, before completion of final mockup.
7. 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.
8. Maintain mockups during construction in an undisturbed condition as a standard for judging the completed Work.
9. Demolish and remove mockups when directed unless otherwise indicated.

L. Laboratory Mockups: Comply with requirements of preconstruction testing and those specified in individual Specification Sections.

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. 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, and the Contract Sum will be adjusted by Change Order.

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 shall 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 01 3300 "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 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 as a component of Contractor's quality-control plan. 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 and other Project-required services paid for by other entities.
2. Distribution: Distribute schedule to Owner and 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.

B. Maintain log at Project site. Post changes and revisions as they occur. Provide access to test and inspection log for Architect's and authorities' having jurisdiction 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 01 7300 "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 4000

SECTION 01 5000 - TEMPORARY FACILITIES AND CONTROLS

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes requirements for temporary utilities, support facilities, and security and protection facilities to extent as applicable to this Work Package and not provided by previous Work Packages.

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, Owner's construction forces, 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.

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, 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.

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 the U.S. Architectural & Transportation Barriers Compliance Board's ADA-ABA Accessibility Guidelines and ICC/ANSI 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, with 1-5/8-inch- OD top rails.

B. Lumber and Plywood: Comply with requirements in Section 06 1053 "Miscellaneous Rough Carpentry."

C. Dust-Control Adhesive-Surface Walk-off Mats: Provide mats minimum 36 by 60 inches.

2.2 TEMPORARY FACILITIES

A. Field Offices, General: 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. Drinking water and private toilet.
4. Heating and cooling equipment necessary to maintain a uniform indoor temperature of 68 to 72 deg F.
5. 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 Units: Listed and labeled for type of fuel being consumed, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

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.

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.

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.

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: Install water service and distribution piping in sizes and pressures adequate for construction.

D. Sanitary Facilities: Provide temporary toilets, wash 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.

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.

F. Ventilation and Humidity Control: Provide temporary ventilation required by construction activities for curing or drying of completed installations or for protecting installed construction from adverse effects of high humidity. Select equipment that will not have a harmful effect on completed installations or elements being installed. Coordinate ventilation requirements to produce ambient condition required and minimize energy consumption.

G. Electric Power Service: Provide electric power service and distribution system of sufficient size, capacity, and power characteristics required for construction operations.

1. Install electric power service overhead or underground unless otherwise indicated.

H. 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.
2. Install lighting for Project identification sign.

I. Telephone Service: Provide temporary telephone service in common-use facilities for use by all construction personnel. Install WiFi cell phone access equipment and one land-based telephone line for 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.

J. Electronic Communication Service: Provide secure WiFi wireless connection to internet with provisions for access by Architect and Owner.

K. Project Computer: Provide a desktop computer in the primary field office adequate for use by Architect and Owner to access Project electronic documents and maintain electronic communications. Equip computer with not less than the following:

1. Processor: Intel Core i5 or i7.
2. Memory: 16 gigabyte.
3. Disk Storage: 1 -terabyte hard-disk drive and combination DVD-RW/CD-RW drive.
4. Display: 24-inch LCD monitor with 256-Mb dedicated video RAM.
5. Full-size keyboard and mouse.
6. Network Connectivity: 10/100BaseT Ethernet.
7. Operating System: Microsoft Windows 10 Professional.
8. Productivity Software:

a. Microsoft Office Professional, 2013 or higher, including Word, Excel, and Outlook.
b. Adobe Reader DC.
c. WinZip 10.0 or higher.

9. Printer: "All-in-one" unit equipped with printer server, combining color printing, photocopying, scanning, and faxing, or separate units for each of these three functions.
10. Internet Service: Broadband modem, router, and ISP, equipped with hardware firewall, providing minimum 10.0 -Mbps upload and 15 -Mbps download speeds at each computer.
11. Internet Security: Integrated software, providing software firewall, virus, spyware, phishing, and spam protection in a combined application.

12. Backup: External hard drive, minimum 2 terrabytes, with automated backup software providing daily backups.

3.4 SUPPORT FACILITIES INSTALLATION

A. General: Comply with the following:

1. Provide construction for temporary offices, shops, and sheds located within construction area or within 30 feet of building lines that is noncombustible according to ASTM E 136. Comply with NFPA 241.
2. 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 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 according to requirements of separate sitework contract.

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 parking areas for construction personnel or, if available, use designated areas of Owner's existing.

F. 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.

G. 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 touchup signs so they are legible at all times.

H. Waste Disposal Facilities:

1. Comply with requirements specified in Section 01 7419 "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 01 7300 "Execution."

I. 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.

3.5 SECURITY AND PROTECTION FACILITIES INSTALLATION

A. Environmental Protection: Provide protection, operate temporary facilities, and conduct construction in ways and by methods that 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 01 1000 "Summary."

B. Temporary Erosion and Sedimentation Control:

1. Comply with requirements of EPA Construction General Permit or authorities having jurisdiction, whichever is more stringent and requirements specified in Section 31 1000 "Site Clearing."
2. Provide measures to prevent soil erosion and discharge of soil-bearing water runoff and airborne dust to undisturbed areas and to adjacent properties and walkways, in accordance with requirements of EPA Construction General Permit or authorities having jurisdiction, whichever is more stringent.

    a. Verify that flows of water redirected from construction areas or generated by construction activity do not enter or cross tree- or plant-protection zones.
    b. Inspect, repair, and maintain erosion- and sedimentation-control measures during construction until permanent vegetation has been established.
    c. Clean, repair, and restore adjoining properties and roads affected by erosion and sedimentation from Project site during the course of Project.
    d. Remove erosion and sedimentation controls, and restore and stabilize areas disturbed during removal.

C. Stormwater Control: Comply with authorities having jurisdiction. Provide barriers in and around excavations and subgrade construction to prevent flooding by runoff of stormwater from heavy rains.

D. Tree and Plant Protection:

1. Comply with requirements specified in Section 01 5639 "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.

E. Pest Control: If a pest problem becomes evident, 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. Obtain extended warranty for Owner. Perform control operations lawfully, using environmentally safe materials.

F. Site Enclosure Fence: Before construction operations begin, furnish and install site enclosure fence in a manner that will prevent people and animals 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.

G. Security Enclosure and Lockup: Install substantial temporary enclosure around partially completed areas of construction. Provide lockable entrances to prevent unauthorized entrance, vandalism, theft, and similar violations of security.

H. Barricades, Warning Signs, and Lights: Comply with requirements of authorities having jurisdiction for erecting structurally adequate barricades, including warning signs and lighting.

I. 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 not complete, insulate temporary enclosures.

J. 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 plywood on construction operations side.

K. 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.

1. Prohibit smoking in construction areas.

2. Supervise welding operations, combustion-type temporary heating units, and similar sources of fire ignition according to 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 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. Operate Project-identification-sign lighting daily from dusk until 12:00 midnight.

D. Temporary Facility Changeover: Do not change over from using temporary security and protection facilities to permanent facilities until Substantial Completion.

E. 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 paving not intended for or acceptable for integration into permanent paving. 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, clean and renovate permanent facilities used during construction period. Comply with final cleaning requirements specified in Section 01 7700 "Closeout Procedures."

END OF SECTION 01 5000

SECTION 01 5723 - TEMPORARY STORM WATER POLLUTION CONTROL

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Temporary stormwater pollution controls.

1.2 STORMWATER POLLUTION PREVENTION PLAN

A. The Stormwater Pollution Prevention Plan (SWPPP) is part of the Contract Documents and is bound into this Project Manual.

1.3 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1. Meet with Owner, Architect, and earthwork subcontractor.
2. Review requirements of the SWPPP, including permitting process, worker training, and inspection and maintenance requirements.

1.4 INFORMATIONAL SUBMITTALS

A. Stormwater Pollution Prevention Plan (SWPP): Within 15 days of date established for commencement of the Work, submit completed SWPPP.

B. EPA authorization under the EPA's "2017 Construction General Permit (CGP)."

C. Stormwater Pollution Prevention (SWPP) Training Log: For each individual performing Work under the SWPPP.

D. Inspection reports.

1.5 QUALITY ASSURANCE

A. Stormwater Pollution Prevention Plan (SWPPP) Coordinator: Experienced individual or firm with a record of successful water pollution control management coordination of projects with similar requirements.

1. SWPPP Coordinator shall complete and finalize the SWPPP form.
2. SWPPP Coordinator shall be responsible for inspections and maintaining of all requirements of the SWPPP.

B. Installers: Trained as indicated in the SWPPP.

PART 2 - PRODUCTS

2.1 TEMPORARY STORMWATER POLLUTION CONTROLS

A. Provide temporary stormwater pollution controls as required by the SWPPP.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Comply with all best management practices, general requirements, performance requirements, reporting requirements, and all other requirements included in the SWPPP.

B. Locate stormwater pollution controls in accordance with the SWPPP.

C. Conduct construction as required to comply with the SWPPP and that minimize possible contamination or pollution or other undesirable effects.

1. Inspect, repair, and maintain SWPPP controls during construction.

    a. Inspect all SWPPP controls not less than every seven days, and after each occurrence of a storm event, as outlined in the SWPPP.

D. Remove SWPPP controls at completion of construction and restore and stabilize areas disturbed during construction.

END OF SECTION 01 5723

SECTION 01 6000 - PRODUCT REQUIREMENTS

PART 1 - GENERAL

1.1 SUMMARY

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

B. Related Requirements:

1. Section 01 1000 "Summary" for Contractor requirements related to Owner-furnished products.
2. Section 01 2500 "Substitution Procedures" for requests for substitutions.
3. Section 01 7700 "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 indicated otherwise.
3. Equal Product: Product by named manufacturer that is demonstrated and approved through the equal product submittal process described in Part 2 "Equal 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. Evaluation of Equal 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 equal 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 equal 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 equal product request or substitution request, if applicable.

D. Equal Product Request Submittal: An action submittal requesting consideration of a equal product, including the following information:

1. Identification of basis-of-design product or fabrication or installation method to be replaced, including Specification Section number and title and Drawing numbers and titles.
2. Data indicating compliance with the requirements specified in Part 2 "Equal Products" Article.
3. Use Owner’s “Equal Product Approval Request Form” in the Owners bidding requirements included in these specifications.

E. Basis-of-Design Product Specification Submittal: An action submittal complying with requirements in Section 01 3300 "Submittal Procedures."

F. Substitution: Refer to Section 01 2500 "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.

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 not conspicuous.
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 equal 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.

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 shall be in addition to, and run concurrent with, other warranties required by the Contract Documents. Manufacturer's disclaimers and limitations on product warranties do not relieve 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 the 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 the 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 01 7700 "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 the 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 "Equal Products" Article to obtain approval for use of an unnamed product.

a. Submit Form for Approval: For products and materials proposed as equal to specified products and materials, fill out and submit “Equal Product Approval Request Form” included in this specification manual.

B. Product Selection Procedures:

1. Sole Product: Where Specifications name a single manufacturer and product, provide the named product that complies with requirements. Equal 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. Equal 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. Equal products or substitutions for Contractor's convenience will not 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. Equal products or substitutions for Contractor's convenience will not 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 equal 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 "Equal 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 01 2500 "Substitution Procedures" for substitutions for convenience.

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 01 2500 "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 EQUAL PRODUCTS

A. Conditions for Consideration of Equal Products: Architect will consider Contractor's request for equal 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. “Equal Product Approval Request Form” has been properly filled out and submitted..
2. 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.
3. 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.

4. Evidence that proposed product provides specified warranty.
5. List of similar installations for completed projects, with project names and addresses and names and addresses of architects and owners, if requested.
6. Samples, if requested.

B. Architect's Action on Equal Products Submittal: If necessary, Architect will request additional information or documentation for evaluation, as specified in Section 01 3300 "Submittal Procedures."

1. Form of Approval of Submittal: As specified in Section 01 3300 "Submittal Procedures."
2. Use product specified if Architect does not issue a decision on use of a equal product request within time allocated.

C. Submittal Requirements, Two-Step Process: Approval by the Architect of Contractor's request for use of equal product is not intended to satisfy other submittal requirements. Comply with specified submittal requirements.

PART 3 - EXECUTION (Not Used)

END OF SECTION 01 6000

SECTION 01 7300 - 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 and surveying.
3. Installation of the Work.
4. Cutting and patching.
5. Progress cleaning.
6. Starting and adjusting.
7. Protection of installed construction.

B. Related Requirements:

1. Section 01 1000 "Summary" for limits on use of Project site.
2. Section 01 3300 "Submittal Procedures" for submitting surveys.
3. Section 01 7700 "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.

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 INFORMATIONAL SUBMITTALS

A. Qualification Data: For land surveyor.

B. Certified Surveys: Submit two copies signed by land surveyor.

C. Certificates: Submit certificate signed by land surveyor, certifying that location and elevation of improvements comply with requirements.

D. 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.

E. Landfill Receipts: Submit copy of receipts issued by a landfill facility, licensed to accept hazardous materials, for hazardous waste disposal.

1.4 CLOSEOUT SUBMITTALS

A. Final Property Survey: Submit 10 copies showing the Work performed and record survey data.

1.5 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. 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.
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.
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.
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.

C. 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.

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.

1. Use cleaning products that comply with Green Seal's GS-37, or if GS-37 is not applicable, use products that comply with the California Code of Regulations maximum allowable VOC levels.

PART 3 - EXECUTION

3.1 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. 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 local utility 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 01 3100 "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.

B. Engage a land surveyor 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 land surveyor to prepare a final property survey showing significant features (real property) for Project. Include on the survey a certification, signed by

land surveyor, 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.
2. Recording: At Substantial Completion, have the final property survey recorded by or with authorities having jurisdiction as the official "property survey."

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.

J. Repair or remove and replace damaged, defective, or nonconforming Work.

1. Comply with Section 01 7700 "Closeout Procedures" for repairing or removing and replacing defective Work.

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. 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 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.

E. 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: 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.

F. 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.

G. 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 OWNER-INSTALLED PRODUCTS

A. Site Access: Provide access to Project site for Owner's construction forces.

B. Coordination: Coordinate construction and operations of the Work with work performed by Owner's construction forces.

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.

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, according to 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 according to written instructions of manufacturer or fabricator of product installed, using only cleaning materials specifically recommended. If specific cleaning materials are not recommended, use cleaning materials that are not hazardous to health or property and that will not damage exposed surfaces.

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 01 7419 "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, completed or in progress, is subject to harmful, dangerous, damaging, or otherwise deleterious exposure during the construction period.

3.9 STARTING AND ADJUSTING

A. Start equipment and operating components to confirm proper operation. Remove malfunctioning units, replace with new units, and retest.

B. Adjust equipment for proper operation. Adjust operating components for proper operation without binding.

C. Test each piece of equipment to verify proper operation. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

D. Manufacturer's Field Service: Comply with qualification requirements in Section 01 4000 "Quality Requirements."

3.10 PROTECTION AND REPAIR 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. Repair Work previously completed and subsequently damaged during construction period. Repair to like-new condition.

C. Comply with manufacturer's written instructions for temperature and relative humidity.

END OF SECTION 01 7300

SECTION 01 7419 - CONSTRUCTION WASTE MANAGEMENT AND DISPOSAL

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes administrative and procedural requirements for the following:

1. Disposing of nonhazardous demolition and construction waste.

B. Related Requirements:

1. Section 31 1000 "Site Clearing" for disposition of waste resulting from site clearing and removal of above- and below-grade improvements.

1.2 DEFINITIONS

A. Construction Waste: Building, structure, and site improvement materials and other solid waste resulting from construction, remodeling, renovation, or repair operations. Construction waste includes packaging.

B. Demolition Waste: Building, structure, and site improvement materials resulting from demolition operations.

C. 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.

1.3 MATERIALS OWNERSHIP

A. Unless otherwise indicated, demolition and construction waste becomes property of Contractor.

1.4 INFORMATIONAL SUBMITTALS

A. Landfill and Incinerator Disposal Records: Indicate receipt and acceptance of waste by landfills and incinerator facilities licensed to accept them. Include manifests, weight tickets, receipts, and invoices.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION

3.1 DISPOSAL OF WASTE

A. General: 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. Except as 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. General: 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: Do not burn waste materials.

END OF SECTION 01 7419

SECTION 01 7700 - 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. Warranties.
4. Final cleaning.

B. Related Requirements:

1. Section 01 2900 "Payment Procedures" for requirements for Applications for Payment for Substantial Completion and Final Completion.
2. Section 01 3233 "Photographic Documentation" for submitting Final Completion construction photographic documentation.
3. Section 01 7823 "Operation and Maintenance Data" for additional operation and maintenance manual requirements.
4. Section 01 7839 "Project Record Documents" for submitting Record Drawings, Record Specifications, and Record Product Data.
5. Section 01 7900 "Demonstration and Training" for requirements to train the 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.

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.

    a. Schedule of Maintenance Material Items: Prepare and submit schedule of maintenance material submittal items, including name and quantity of each item and name and number of related Specification Section. Obtain Architect's Owner's signature for receipt of submittals.

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 01 7900 "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 01 2900 "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 shall state that each item has been completed or otherwise resolved for acceptance.
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 one of the following formats:

    a. MS Excel 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 by uploading to web-based project software site.

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.

1. Use cleaning products that comply with Green Seal's GS-37, or if GS-37 is not applicable, use products that comply with the California Code of Regulations maximum allowable VOC levels.

PART 3 - EXECUTION

3.1 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 according to manufacturer's recommendations.

i. Vacuum and mop concrete.
j. Vacuum carpet and similar soft surfaces, removing debris and excess nap; clean according to manufacturer's recommendations 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.

q. Clean luminaires, lamps, globes, and reflectors to function with full efficiency.
r. Clean strainers.
s. Leave Project clean and ready for occupancy.

C. Construction Waste Disposal: Comply with waste-disposal requirements in Section 01 7419 "Construction Waste Management and Disposal."

3.2 REPAIR OF THE WORK

A. Complete repair and restoration operations required by Section 01 7300 "Execution" before requesting inspection for determination of Substantial Completion.

END OF SECTION 01 7700

SECTION 01 7823 - 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 01 3300 "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 01 7700 "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.

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 shall 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 Architect.

7. Names and contact information for major consultants to the Architect that designed the systems contained in the manuals.
8. 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 according to 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.

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 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 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:

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 7823

SECTION 01 7839 - 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 01 7300 "Execution" for final property survey.
2. Section 01 7700 "Closeout Procedures" for general closeout procedures.
3. Section 01 7823 "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 copies of Record Drawings as follows:

a. Submittal:

1) Submit PDF electronic files of scanned record prints and one set(s) of file prints.
2) 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 weekly 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 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: Same digital data software program, version, and operating system as for the original Contract Drawings.
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 01 3100 "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.

B. Format: Identify and date each Record Drawing; include the designation "PROJECT RECORD DRAWING" in a prominent location.

1. 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.
2. Identification: As follows:

    a. Project name.
    b. Date.
    c. Designation "PROJECT RECORD DRAWINGS."
    d. Name of Architect.
    e. Name of Contractor.

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, Record Product Data, 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, Record Specifications, 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 7839

SECTION 01 7900 - 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. Qualification Data: For facilitator.

C. Attendance Record: For each training module, submit list of participants and length of instruction time.

D. 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 Contractor.
e. Date of video recording.

2. Transcript: 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.

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.

B. Instructor Qualifications: A factory-authorized service representative, complying with requirements in Section 01 4000 "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 01 3100 "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.
    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 01 7823 "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 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 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, through Architect, 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 an oral 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 with vibration reduction technology.

1. Submit video recordings by uploading to web-based Project software site.
2. File Hierarchy: Organize folder structure and file locations according to 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 according to 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.

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

PART 3 - EXECUTION

END OF SECTION 01 7900

SECTION 02 4116 - STRUCTURE DEMOLITION

PART 1 - GENERAL

1.1 SUMMARY

A. The Work of this Section Includes:

1. Demolition and removal of buildings or structures.
2. Demolition and removal of site improvements.
3. Removing below-grade construction.
4. Disconnecting, capping or sealing, and abandoning in-place site utilities.
5. Salvaging items for reuse by Owner.

B. Related Requirements:

1. Section 01 1000 "Summary" for use of the premises and phasing requirements.
2. Section 01 3200 "Construction Progress Documentation" for preconstruction photographs taken before building demolition.
3. Section 31 1000 "Site Clearing" for site clearing and removal of above- and below-grade site improvements that are not part of building demolition.

1.2 DEFINITIONS

A. Remove: Detach items from existing construction and dispose of them off-site unless indicated to be salvaged.

B. Remove and Salvage: Detach items from existing construction, in a manner to prevent damage, and deliver to Owner as indicated. Include fasteners or brackets needed for reattachment elsewhere.

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 PREINSTALLATION MEETINGS

A. Predemolition Conference: Conduct conference at Project site.

1. Inspect and discuss condition of construction to be demolished.
2. Review and finalize demolition schedule and verify availability of materials, demolition personnel, equipment, and facilities needed to make progress and avoid delays.
3. Review requirements of work performed by other trades that rely on substrates exposed by demolition operations.
4. Review areas where existing construction is to remain and requires protection.
5. Review procedures for noise control and dust control.
6. Review and finalize protection requirements.
7. Review procedures for protection of adjacent buildings.
8. Asbestos and hazardous material removal and procedures. Materials include:

    a. Caulking at exterior windows.
    b. Tar around roof penetrations and at perimeter of roof.

9. Procedures for addressing unforeseen materials exposed during demolition operations.
10. Review potential HAZMATS and process, if encountered.

1.5 INFORMATIONAL SUBMITTALS

A. Qualification Statements: For refrigerant recovery technician.

B. Engineering Survey: Submit engineering survey of condition of building.

C. Survey of Existing Conditions: Submit survey.

D. 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.

1. Adjacent Buildings: Detail special measures proposed to protect adjacent buildings to remain.

E. Schedule of Building Demolition Activities: Indicate the following:

1. Detailed sequence of demolition work, with starting and ending dates for each activity.
2. Temporary interruption of utility services. Indicate how long services will be interrupted.
3. Coordination for shutoff and capping or re-routing of utility services.

F. 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.

1.6 CLOSEOUT SUBMITTALS

A. Inventory: Submit a list of items that have been removed and salvaged.

1.7 QUALITY ASSURANCE

A. Refrigerant Recovery Technician Qualifications: certified by an EPA-approved certification program.

1.8 FIELD CONDITIONS

A. Buildings to be demolished will be vacated and their use discontinued before start of the Work.

B. Buildings immediately adjacent to demolition area, such as existing high school west of the building, will be occupied. Conduct building demolition so operations of occupied buildings will not be disrupted.

1. Provide not less than 72 hours' notice of activities that will affect operations of adjacent occupied buildings.
2. Maintain access to existing walkways, exits, and other facilities used by occupants of adjacent buildings.

a. Do not close or obstruct walkways, exits, or other facilities used by occupants of adjacent buildings without written permission from authorities having jurisdiction.

C. Conditions existing at time of inspection for bidding purpose will be maintained by Owner as far as practical.

1. Coordinate with Owner to determine items that Owner may want to remove prior to demolition Work.

D. Hazardous Materials: Hazardous materials are present in building to be demolished. A report on the presence of hazardous materials is on file for review and use. Examine report to become aware of locations where hazardous materials are present.

1. Engage specialist and comply with specialist’s recommendations for safe removal or these materials where applicable.
2. Do not disturb hazardous materials or items suspected of containing hazardous materials except according to procedures recommended by specialist in removal of hazardous materials.
3. Abatement is to be dealt with according to Owner’s guidelines, which may be obtained from the Owner.
4. Owner will provide material safety data sheets for suspected hazardous materials that are known to be present in buildings to be demolished.

E. On-site sale of removed items or materials is not permitted.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Regulatory Requirements: Comply with governing EPA notification regulations before beginning demolition. Comply with hauling and disposal regulations of authorities having jurisdiction.

B. Standards: Comply with ANSI/ASSP A10.6 and NFPA 241.

2.2 SOIL MATERIALS

A. Satisfactory Soils: Comply with requirements in Section 31 2000 "Earth Moving."

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verify that utilities have been disconnected and capped before starting 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.

C. Perform an engineering survey of condition of building to determine whether removing any element might result in structural deficiency or unplanned collapse of any portion of structure or adjacent structures during building demolition operations.

D. Verify that hazardous materials have been remediated before proceeding with building demolition operations.

E. Survey of Existing Conditions: Record existing conditions by use of preconstruction photographs or video and templates. Comply with Section 01 3233 "Photographic Documentation."

1. Inventory and record the condition of items to be removed and salvaged. Photograph or video conditions that might be misconstrued as damage caused by removal.
2. Photograph or video existing conditions of adjoining construction and site improvements, including finish surfaces, that might be misconstrued as damage caused by demolition operations or removal of items for salvage.

3.2 PREPARATION

A. Existing Facilities: Protect adjacent walkways, loading docks, building entries, and other building facilities during demolition operations. Maintain exits from existing buildings.

B. Temporary Shoring: Provide and maintain interior and exterior shoring, bracing, or structural support to preserve stability and prevent unexpected movement or collapse of construction being demolished.

1. Strengthen or add new supports when required during progress of demolition.

C. Temporary Protection: Erect temporary protection, such as walks, fences, railings, canopies, and covered passageways, where required by authorities having jurisdiction and as indicated. Comply with requirements in Section 01 5000 "Temporary Facilities and Controls."

1. Protect adjacent buildings and facilities from damage due to demolition activities.
2. Protect existing site improvements, appurtenances, and landscaping to remain.
3. Erect a plainly visible fence around drip line of individual trees or around perimeter drip line of groups of trees to remain.
4. Provide temporary barricades and other protection required to prevent injury to people and damage to adjacent buildings and facilities to remain.
5. Provide protection to ensure safe passage of people around building demolition area and to and from occupied portions of adjacent buildings and structures.
6. Protect walls, windows, roofs, and other adjacent exterior construction that are to remain and that are exposed to building demolition operations.
7. Erect and maintain dustproof partitions and temporary enclosures to limit dust, noise, and dirt migration to occupied portions of adjacent buildings.

D. Existing Utilities to Remain: Maintain utility services to remain and protect against damage during demolition operations.

1. Do not interrupt existing utilities serving adjacent occupied or operating facilities unless authorized in writing by Owner and authorities having jurisdiction.
2. Provide temporary services during interruptions to existing utilities, as acceptable to Owner and authorities having jurisdiction.

    a. Provide at least 72 hours' notice to occupants of affected buildings if shutdown of service is required during changeover.

E. Existing Utilities to Be Disconnected: Locate, identify, disconnect, and seal or cap off utilities serving buildings and structures to be demolished.

1. Arrange to shut off utilities with utility companies.
2. If disconnection of utility services will affect adjacent occupied buildings, then provide temporary utilities that bypass buildings and structures to be demolished and that maintain continuity of service to other buildings and structures.
3. Cut off pipe or conduit a minimum of 24 inches below grade at or outside the building or structure to be demolished and cap, valve, or plug and seal remaining portion of pipe or conduit after bypassing in accordance with requirements of authorities having jurisdiction.
4. Do not start demolition work until utility disconnecting and sealing have been completed and verified in writing by authorities having jurisdiction.

F. Refrigerant: Before starting demolition, remove refrigerant from mechanical equipment in accordance with 40 CFR 82 and regulations of authorities having jurisdiction.

3.3 SALVAGE

A. Coordinate with Owner to determine items to be removed and salvaged, if any.

B. Comply with the following for salvaged items:

1. Clean salvaged items of dirt and demolition debris.
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 storage area designated by Owner.
5. Protect items from damage during transport and storage.

3.4 DEMOLITION, GENERAL

A. General: Demolish indicated buildings and site improvements completely. Use methods required to complete the Work within limitations of governing regulations and as follows:

1. Do not use cutting torches until work area is cleared of flammable materials. Maintain portable fire-suppression devices during flame-cutting operations.
2. Maintain adequate ventilation when using cutting torches.
3. Locate building demolition equipment and remove debris and materials so as not to impose excessive loads on supporting walls, floors, or framing.

B. Site Access and Temporary Controls: Conduct building 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.

C. Explosives: Use of explosives is not permitted.

3.5 DEMOLITION BY MECHANICAL MEANS

A. Proceed with demolition of structural framing members systematically, from higher to lower level. Complete building demolition operations above each floor or tier before disturbing supporting members on the next lower level.

B. Remove debris from elevated portions of the building by chute, hoist, or other device that will convey debris to grade level in a controlled descent.

1. Remove structural framing members and lower to ground by method suitable to minimize ground impact and dust generation.

C. Below-Grade Construction:

1. Demolish foundation systems and other below-grade construction that are within footprint of new construction and extending 5 ft. outside footprint indicated for new construction. Abandon below-grade construction outside this area.

   a. Remove below-grade construction, including basements, foundation systems, and footings, completely.

2. Demolish foundation systems and other below-grade construction.

   a. Remove below-grade construction, including basements, foundation systems, and footings, completely.

D. Existing Utilities:

1. Abandon existing utilities and below-grade utility structures. Cut utilities flush with grade.
2. Where required, demolish existing utilities and below-grade utility structures that are within 5 ft. outside footprint indicated for new construction. Abandon utilities outside this area.

   a. Fill abandoned utility structures with satisfactory soil materials in accordance with backfill requirements in Section 31 2000 "Earth Moving."

3.6 SITE RESTORATION

A. Below-Grade Areas:

1. Rough grade below-grade areas ready for further excavation or new construction.
2. Completely fill below-grade areas and voids resulting from building demolition operations with satisfactory soil materials in accordance with backfill requirements in Section 31 2000 "Earth Moving."

B. Site Grading: Uniformly rough grade area of demolished construction to a smooth surface, free from irregular surface changes. Provide a smooth transition between adjacent existing grades and new grades.

3.7 REPAIRS

A. Promptly repair damage to adjacent buildings caused by demolition operations.

3.8 DISPOSAL OF DEMOLISHED MATERIALS

A. Remove demolition waste materials from Project site and dispose of them in an EPA-approved construction and demolition waste landfill acceptable to authorities having jurisdiction.

1. Do not allow demolished materials to accumulate on-site.
2. Remove and transport debris in a manner that will prevent spillage on adjacent surfaces and areas.

B. Do not burn demolished materials.

3.9 CLEANING

A. Clean adjacent structures and improvements of dust, dirt, and debris caused by building demolition operations. Return adjacent areas to condition existing before building demolition operations began.

1. Clean roadways of debris caused by debris transport.

END OF SECTION 02 4116

SECTION 03 1000 - CONCRETE FORMING AND ACCESSORIES

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Form-facing material for cast-in-place concrete.
2. Board form liners.
3. Shoring, bracing, and anchoring.

B. Related Requirements:

1. Section 32 1313 "Concrete Paving" for formwork related to concrete pavement and walks.

1.2 DEFINITIONS

A. Architectural Concrete: High-quality architectural concrete includes all exposed-to-view vertical concrete surfaces. Architectural concrete has no less than the following characteristics:

1. Proper and consistent alignment of form panels and form ties. (There will be no form ties visible at infilled exterior openings.)
2. Absence of staining from form leakage.
3. Absence of honeycomb or excessive segregation due to improper vibration or form leakage.
4. Correct placement of rustication or other detail treatment as shown on drawings.
5. Truly square and plumb corners unless clearly directed otherwise.
6. Absence of markings from formwork.

B. Design Reference Sample: Sample designated by Architect in the Contract Documents that reflects acceptable surface quality and appearance of cast-in-place board form concrete.

C. Form-Facing Material: Temporary structure or mold for the support of concrete while the concrete is setting and gaining sufficient strength to be self-supporting.

D. Formwork: The total system of support of freshly placed concrete, including the mold or sheathing that contacts the concrete, as well as supporting members, hardware, and necessary bracing.

1.3 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1. Review the following:

    a. Special inspection and testing and inspecting agency procedures for field quality control.
    b. Construction, movement, contraction, and isolation joints
    c. Forms and form-removal limitations.
    d. Shoring and reshoring procedures.
    e. Anchor rod and anchorage device installation tolerances.
    f. Affirmation of areas required to have high quality architectural concrete surfaces.

1.4 ACTION SUBMITTALS

A. Product Data: For each of the following:

1. Exposed surface form-facing material.
2. Concealed surface form-facing material.
3. Void forms.
4. Form ties.
5. Waterstops.
6. Form-release agent.

B. Shop Drawings: Prepared by, and signed and sealed by, a qualified professional engineer responsible for their preparation, detailing fabrication, assembly, and support of forms.

1. For exposed vertical concrete walls, indicate dimensions and form tie locations.
2. Indicate dimension and locations of construction and movement joints required to construct the structure in accordance with ACI 301.

    a. Location of construction joints is subject to approval of the Architect.

3. Indicate proposed schedule and sequence of stripping of forms, shoring removal, and reshoring installation and removal.

4. Formwork for Textured Finished (Board Form) Walls: Prepared by, and signed and sealed by, a qualified professional engineer responsible for their preparation, detailing fabrication, assembly, and support of forms.

    a. Show formwork construction, including form-liner layout, form-liner termination details, dimensioned locations of form-facing material joints, rustications, construction and contraction joints, form joint-sealant details, form-tie locations and patterns, inserts and embedments, cutouts, cleanout panels, and other items that visually affect cast-in-place architectural concrete.

        1) Included separate layout for formwork used in field sample panels and mockups.
        2) Indicate proposed schedule and sequence of stripping of forms, shoring removal, and reshoring installation and removal.
        3) Location of construction joints is subject to approval of Architect.

C. Samples:

1. Form-facing panels.
2. For Form Liners: 12-inch by 12-inch sample, indicating texture.

1.5 INFORMATIONAL SUBMITTALS

A. Qualification Data: For testing and inspection agency.

B. Research Reports: For insulating concrete forms indicating compliance with International Code Council Acceptance Criteria AC353.

C. Field quality-control reports.

D. Minutes of preinstallation conference.

1.6 QUALITY ASSURANCE

A. Testing and Inspection Agency Qualifications: An independent agency, acceptable to authorities having jurisdiction, qualified in accordance with ASTM C1077 and ASTM E329 for testing indicated.

B. Field Sample Panels for Textured Concrete: After approval of verification sample and before casting architectural board formed concrete, produce field sample panels to demonstrate the approved range of selections made under Sample submittals. Produce a minimum of three sets of full-scale panels, cast vertically, approximately 48 by 48 by 6 inches minimum, to demonstrate the expected range of finish, color, and texture variations.

1. Locate panels as indicated or, if not indicated, as directed by Architect.
2. Demonstrate methods of curing, aggregate exposure, wood sealers, and coatings, as applicable.
3. In presence of Architect, damage part of an exposed-face surface for each finish, color, and texture, and demonstrate materials and techniques proposed for repair of tie holes and surface blemishes to match adjacent undamaged surfaces.
4. Maintain field sample panels during construction in an undisturbed condition as a standard for judging the completed Work.
5. Demolish and remove field sample panels when directed.

C. Mockups: Formed surfaces to demonstrate typical joints, surface finish, texture, tolerances, and standard of workmanship.

1. Build panel approximately 100 sq. ft. in the location indicated or, if not indicated, as directed by Architect.
2. Subject to compliance with requirements, approved mockups may become part of the completed Work.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Waterstops: Store waterstops under cover to protect from moisture, sunlight, dirt, oil, and other contaminants.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Concrete Formwork: Design, engineer, erect, shore, brace, and maintain formwork, shores, and reshores in accordance with ACI 301, to support vertical, lateral, static, and dynamic loads, and construction loads that might be applied, until structure can support such loads, so that resulting concrete conforms to the required shapes, lines, and dimensions.

1. Design wood panel forms in accordance with APA's "Concrete Forming Design/Construction Guide."
2. Design formwork to limit deflection of form-facing material to 1/240 of center-to-center spacing of supports.

a. For architectural concrete, limit deflection of form-facing material, studs, and walers to 0.0025 times their respective clear spans (L/400).

2.2 FORM-FACING MATERIALS

A. As-Cast Surface Form-Facing Material:

1. Provide continuous, true, and smooth concrete surfaces.
2. Furnish in largest practicable sizes to minimize number of joints.
3. Acceptable Materials: As required to comply with Surface Finish designations specified in Section 03 3000 "Cast-In-Place Concrete, and as follows:

a. Plywood, metal, or other approved panel materials.
b. Exterior-grade plywood panels, suitable for concrete forms, complying with DOC PS 1, and as follows:

1) APA MDO (medium-density overlay); mill-release agent treated and edge sealed.

B. Form Liners for Board Form Concrete: Units of face design, texture, arrangement, and configuration to match design reference sample. Furnish with manufacturer's recommended liquid-release agent that will not bond with, stain, or adversely affect concrete surfaces and will not impair subsequent surface treatments and finishes of concrete.

1. Form Liners:

a. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1) Architectural Polymers, Inc.
2) Fitzgerald Formliners.
3) Sika Corporation.
4) Spec Formliners, Inc.

b. Face Pattern: Smooth or texture pattern as indicated.

C. Concealed Surface Form-Facing Material: Lumber, plywood, metal, plastic, or another approved material.

1. Provide lumber dressed on at least two edges and one side for tight fit.

D. Void Forms: Biodegradable paper surface, treated for moisture resistance, structurally sufficient to support weight of plastic concrete and other superimposed loads.

2.3 WATERSTOPS

A. Self-Expanding Butyl Strip Waterstops: Manufactured rectangular or trapezoidal strip, butyl rubber with sodium bentonite or other hydrophilic polymers, for adhesive bonding to concrete, 3/4 by 1 inch.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Carlisle Coatings & Waterproofing Inc.
b. CETCO, a Minerals Technologies company.
c. Henry Company.
d. JP Specialties, Inc.
e. Sika Corporation.

2.4 RELATED MATERIALS

A. Chamfer Strips: Wood, metal, PVC, or rubber strips, 3/4 by 3/4 inch, minimum.

B. Rustication Strips: Wood, metal, PVC, or rubber strips, kerfed for ease of form removal.

C. Form-Release Agent: Commercially formulated form-release agent that does not bond with, stain, or adversely affect concrete surfaces and does not impair subsequent treatments of concrete surfaces.

1. Formulate form-release agent with rust inhibitor for steel form-facing materials.

D. Form Ties: Factory-fabricated, removable or snap-off, glass-fiber-reinforced plastic or metal form ties designed to resist lateral pressure of fresh concrete on forms and to prevent spalling of concrete on removal.

1. Furnish units that leave no corrodible metal closer than 1 inch to the plane of exposed concrete surface.

2. Furnish ties that, when removed, leave holes no larger than 1 inch in diameter in concrete surface.

PART 3 - EXECUTION

3.1 INSTALLATION OF FORMWORK

A. Comply with ACI 301.

B. Construct formwork, so concrete members and structures are of size, shape, alignment, elevation, and position indicated, within tolerance limits of ACI 117 and to comply with the Surface Finish designations specified in Section 03 3000 "Cast-In-Place Concrete" for as-cast finishes.

C. Limit concrete surface irregularities as follows:

1. Surface Finish-2.0: ACI 117 Class B, 1/4 inch.
2. Surface Finish-3.0 at Exposed Concrete: ACI 117 Class A, 1/8 inch.

D. Construct forms tight enough to prevent loss of concrete mortar.

1. Minimize joints.
2. Exposed Concrete: Symmetrically align joints in forms.

E. Exposed Concrete (Architectural Concrete): Install formwork for exposed concrete to allow for a high-quality consistent appearance at all exposed-to-view concrete and concrete surfaces receiving waterproofing. Formwork for exposed concrete to have no less than the following characteristics:

1. Proper and consistent alignment of form panels and form ties.
2. Absence of staining from form leakage.
3. Absence of honeycomb or excessive segregation due to improper vibration or form leakage.
4. Correct placement of rustication or other detail treatment as shown on Drawings.
5. Truly square and plumb corners unless clearly directed otherwise.
6. Absence of markings from formwork (i.e. use MDF or plastic forms).

F. Construct removable forms for easy removal without hammering or prying against concrete surfaces.

1. Provide crush or wrecking plates where stripping may damage cast-concrete surfaces.
2. Provide top forms for inclined surfaces steeper than 1.5 horizontal to 1 vertical.
3. Install keyways, reglets, recesses, and other accessories, for easy removal.

G. Do not use rust-stained, steel, form-facing material.

H. Set edge forms, bulkheads, and intermediate screed strips for slabs to achieve required elevations and slopes in finished concrete surfaces.

1. Provide and secure units to support screed strips
2. Use strike-off templates or compacting-type screeds.

I. Provide temporary openings for cleanouts and inspection ports where interior area of formwork is inaccessible.

1. Close openings with panels tightly fitted to forms and securely braced to prevent loss of concrete mortar.
2. Locate temporary openings in forms at inconspicuous locations.

J. Chamfer Do not chamfer exterior corners and edges of permanently exposed concrete.

K. At construction joints, overlap forms onto previously placed concrete not less than 12 inches.

L. Form openings, chases, offsets, sinkages, keyways, reglets, blocking, screeds, and bulkheads required in the Work.

1. Determine sizes and locations from trades providing such items.
2. Obtain written approval of Architect prior to forming openings not indicated on Drawings.

M. Formwork for Architectural Concrete:

1. Conform to requirements of Architectural Concrete section of ACI 301.
2. Arrange joints in facing material in geometric pattern as approved by the Architect.
3. Seal joints to prevent leakage of paste using demonstrated effective method that will not affect appearance of finished surface.
4. Locate form ties in symmetric pattern within panels as shown or as approved by Architect.

N. Construction and Movement Joints:

1. Construct joints true to line with faces perpendicular to surface plane of concrete.
2. Install so strength and appearance of concrete are not impaired, at locations indicated or as approved by Architect.
3. Place joints perpendicular to main reinforcement.
4. Locate joints for beams, slabs, joists, and girders in the middle third of spans.

    a. 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.

    a. Locate joints beside piers integral with walls, near corners, and in concealed locations where possible.

O. Place form boards accurately to provide finished surface texture indicated. Provide solid backing and attach securely to prevent deflection and maintain stability of lining during

concreting. Seal joints of forms and form lining to prevent mortar leaks. Coat form lining boards with form-release agent. Add 1 inch to width of formwork and form ties to accommodate nominal 1 by 4 inch boards where required for formed finish and so as not to reduce scheduled wall thickness Provide temporary ports or openings in formwork where required to facilitate cleaning and inspection.

1. Locate ports and openings in bottom of vertical forms, in inconspicuous location, to allow flushing water to drain.
2. Close temporary ports and openings with tight-fitting panels, flush with inside face of form, and neatly fitted, so joints will not be apparent in exposed concrete surfaces.

P. Clean forms and adjacent surfaces to receive concrete. Remove chips, wood, sawdust, dirt, and other debris just before placing concrete.

Q. Retighten forms and bracing before placing concrete, as required, to prevent mortar leaks and maintain proper alignment.

R. Coat contact surfaces of forms with form-release agent, according to manufacturer's written instructions, before placing reinforcement.

3.2 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 anchor rods, accurately located, to elevations required and complying with tolerances in Section 7.5 of AISC 303.
3. Clean embedded items immediately prior to concrete placement.

3.3 INSTALLATION OF WATERSTOPS

A. Self-Expanding Strip Waterstops: Install in construction joints and at other locations indicated on Drawings, according to manufacturer's written instructions, by adhesive bonding, mechanically fastening, and firmly pressing into place.

1. Install in longest lengths practicable.
2. Locate waterstops in center of joint unless otherwise indicated on Drawings.
3. Protect exposed waterstops during progress of the Work.

3.4 REMOVING AND REUSING FORMS

A. Formwork for sides of beams, walls, and similar parts of the Work that does not support weight of concrete may be removed after cumulatively curing at not less than 50 deg F for 24 hours after placing concrete. Concrete has to be hard enough to not be damaged by form-removal operations, and curing and protection operations need to be maintained.

1. Leave formwork for beam soffits, joists, slabs, and other structural elements that support weight of concrete in place until concrete has achieved at least 70 percent of its 28-day design compressive strength.
2. Remove forms only if shores have been arranged to permit removal of forms without loosening or disturbing shores.

B. Clean and repair surfaces of forms to be reused in the Work.

1. Split, frayed, delaminated, or otherwise damaged form-facing material are unacceptable for exposed surfaces.
2. Apply new form-release agent.

C. When forms are reused, clean surfaces, remove fins and laitance, and tighten to close joints.

1. Align and secure joints to avoid offsets.
2. Do not use patched forms for exposed concrete surfaces unless approved by Architect.

3.5 FIELD QUALITY CONTROL

A. Special Inspections: Owner will engage a special inspector and qualified testing and inspecting agency to perform field tests and inspections and prepare test reports.

B. Inspections:

1. Inspect formwork for shape, location, and dimensions of the concrete member being formed.

END OF SECTION 03 1000

SECTION 03 2000 - CONCRETE REINFORCING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Steel reinforcement bars.
2. Welded-wire reinforcement.

B. Related Requirements:

1. Section 32 1313 "Concrete Paving" for reinforcing related to concrete pavement and walks.

1.2 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1. Review the following:

a. Special inspection and testing and inspecting agency procedures for field quality control.
b. Construction contraction and isolation joints.
c. Steel-reinforcement installation.

1.3 ACTION SUBMITTALS

A. Product Data: For the following:

1. Each type of steel reinforcement.
2. Bar supports.

B. Shop Drawings: Comply with ACI SP-066:

1. Include placing drawings that detail fabrication, bending, and placement.
2. Include bar sizes, lengths, materials, grades, bar schedules, stirrup spacing, bent bar diagrams, bar arrangement, location of splices, lengths of lap splices, details of mechanical splice couplers, details of welding splices, tie spacing, hoop spacing, and supports for concrete reinforcement.

C. Construction Joint Layout: Indicate proposed construction joints required to build the structure.

1. Location of construction joints is subject to approval of the Architect.

1.4 INFORMATIONAL SUBMITTALS

A. Material Test Reports: For the following, from a qualified testing agency:

1. Steel Reinforcement:

B. Field quality-control reports.

C. Minutes of preinstallation conference.

1.5 QUALITY ASSURANCE

A. Mockups: Reinforcing for cast-concrete formed surfaces, to demonstrate tolerances and standard of workmanship.

1. Build panel approximately 100 sq. ft. for formed surface in the location indicated on Drawings or, if not indicated, as directed by Architect.
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. Steel Reinforcement: Deliver, store, and handle steel reinforcement to prevent bending and damage.

1. Store reinforcement to avoid contact with earth.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Structural Performance of Structural Thermal Break Insulating Connection System: Structural thermal break insulated connection system shall withstand the following loads and stresses:

1. Dead Loads: As indicated on Drawings.

a. Shear Load: As indicated on Drawings.
b. Bending Moment: As indicated on Drawings.

2. Live Loads: As indicated on Drawings.

a. Shear Load: As indicated on Drawings.
b. Bending Moment: As indicated on Drawings.

2.2 STEEL REINFORCEMENT

A. Reinforcing Bars: ASTM A615/A615M, Grade 60, deformed.

B. Headed-Steel Reinforcing Bars: ASTM A970/A970M.

C. Plain-Steel Welded-Wire Reinforcement: ASTM A1064/A1064M, plain, fabricated from as-drawn steel wire into flat sheets.

2.3 REINFORCEMENT ACCESSORIES

A. Joint Dowel Bars: ASTM A615/A615M, Grade 60, plain-steel bars, cut true to length with ends square and free of burrs.

B. Bar Supports: Bolsters, chairs, spacers, and other devices for spacing, supporting, and fastening reinforcing bars and welded-wire reinforcement in place.

1. Manufacture bar supports from steel wire, plastic, or precast concrete in accordance with CRSI's "Manual of Standard Practice," of greater compressive strength than concrete and as follows:

a. For concrete surfaces exposed to view, where legs of wire bar supports contact forms, use CRSI Class 1 plastic-protected steel wire, all-plastic bar supports, or CRSI Class 2 stainless steel bar supports.

C. Steel Tie Wire: ASTM A1064/A1064M, annealed steel, not less than 0.0508 inch in diameter.

1. Finish: Plain.

2.4 FABRICATING REINFORCEMENT

A. Fabricate steel reinforcement according to CRSI's "Manual of Standard Practice."

PART 3 - EXECUTION

3.1 PREPARATION

A. Protection of In-Place Conditions:

1. Do not cut or puncture vapor retarder.
2. Repair damage and reseal vapor retarder before placing concrete.

B. Clean reinforcement of loose rust and mill scale, earth, ice, and other foreign materials that reduce bond to concrete.

3.2 INSTALLATION OF STEEL REINFORCEMENT

A. Comply with CRSI's "Manual of Standard Practice" for placing and supporting reinforcement.

B. Accurately position, support, and secure reinforcement against displacement.

1. Locate and support reinforcement with bar supports to maintain minimum concrete cover.
2. Do not tack weld crossing reinforcing bars.

C. Preserve clearance between bars of not less than 1 inch, not less than one bar diameter, or not less than 1-1/3 times size of large aggregate, whichever is greater.

D. Provide concrete coverage in accordance with ACI 318.

E. Set wire ties with ends directed into concrete, not toward exposed concrete surfaces.

F. Splices: Lap splices as indicated on Drawings.

1. Bars indicated to be continuous, and all vertical bars shall be lapped as indicated on Drawings.
2. Stagger splices in accordance with ACI 318.

G. Install welded-wire reinforcement in longest practicable lengths.

1. Support welded-wire reinforcement in accordance with CRSI "Manual of Standard Practice."

    a. For reinforcement less than W4.0 or D4.0, continuous support spacing shall not exceed 12 inches.

2. Lap edges and ends of adjoining sheets at least one wire spacing plus 2 inches for plain wire and 8 inches for deformed wire.
3. Offset laps of adjoining sheet widths to prevent continuous laps in either direction.
4. Lace overlaps with wire.

3.3 JOINTS

A. Construction Joints: Install so strength and appearance of concrete are not impaired, at locations indicated or as approved by Architect.

1. Place joints perpendicular to main reinforcement.
2. Continue reinforcement across construction joints unless otherwise indicated.
3. Do not continue reinforcement through sides of strip placements of floors and slabs.

B. Doweled Joints: Install dowel bars and support assemblies at joints where indicated. Lubricate or asphalt coat one-half of dowel length, to prevent concrete bonding to one side of joint.

3.4 INSTALLATION TOLERANCES

A. Comply with ACI 117.

3.5 FIELD QUALITY CONTROL

A. Special Inspections: Owner will engage a special inspector and qualified testing and inspecting agency to perform field tests and inspections and prepare test reports.

B. Inspections:

1. Steel-reinforcement placement.

END OF SECTION 03 2000

SECTION 03 3000 - CAST-IN-PLACE CONCRETE

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Concrete standards.
2. Concrete materials.
3. Admixtures.
4. Vapor retarders.
5. Curing materials.
6. Accessories.
7. Repair materials.
8. Concrete mixture materials.
9. Concrete mixture class types.
10. Concrete mixing.
11. Architectural concrete requirements.

B. Related Requirements:

1. Section 03 1000 "Concrete Forming and Accessories" for form-facing materials.
2. Section 03 2000 "Concrete Reinforcing" for steel reinforcing bars and welded-wire reinforcement.
3. Section 31 2000 "Earth Moving" for drainage fill under slabs-on-ground.
4. Section 32 1313 "Concrete Paving" for concrete pavement and walks.

1.2 DEFINITIONS

A. Architectural Concrete: High-quality concrete. Architectural Concrete includes all exposed-to-view vertical concrete surfaces. Architectural concrete has no less than the following characteristics:

1. Proper and consistent alignment of form panels.
2. Absence of staining from form leakage.
3. Absence of honeycomb or excessive segregation due to improper vibration or form leakage.
4. Correct placement of rustication or other detail treatment as shown on drawings.
5. Truly square and plumb corners unless clearly directed otherwise.
6. Absence of markings from formwork.

B. Cementitious Materials: Portland cement alone or in combination with one or more of the following: blended hydraulic cement, fly ash, slag cement, other pozzolans, and silica fume; materials subject to compliance with requirements.

C. Water/Cement Ratio (w/cm): The ratio by weight of 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 concrete design mixtures.
    c. Ready-mix concrete manufacturer.
    d. Concrete 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. Methods for achieving specified floor and slab flatness and levelness.
    k. Floor and slab flatness and levelness measurements.
    l. Concrete repair procedures.
    m. Concrete protection.
    n. Initial curing and field curing of field test cylinders (ASTM C31/C31M.)
    o. Protection of field cured field test cylinders.

1.4 ACTION SUBMITTALS

A. Product Data: For each of the following.

1. Portland cement.
2. Fly ash.
3. Aggregates.
4. Admixtures:

    a. Include limitations of use, including restrictions on cementitious materials, supplementary cementitious materials, air entrainment, aggregates, temperature at time of concrete placement, relative humidity at time of concrete placement, curing conditions, and use of other admixtures.

5. Vapor retarders.

6. Curing materials.
7. Joint fillers.
8. Repair materials.

B. Design Mixtures: For each concrete mixture, include the following:

1. Mixture identification.
2. Minimum 28-day compressive strength.
3. Durability exposure class.
4. Maximum w/cm.
5. Calculated equilibrium unit weight, for lightweight concrete.
6. Slump limit.
7. Air content.
8. Nominal maximum aggregate size.
9. Indicate amounts of mixing water to be withheld for later addition at Project site if permitted.
10. Intended placement method.
11. Submit alternate design mixtures when characteristics of materials, Project conditions, weather, test results, or other circumstances warrant adjustments.

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 Mixtures" 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. Curing process.

1.5 INFORMATIONAL SUBMITTALS

A. Qualification Data: For the following:

1. Installer: Include copies of applicable ACI certificates.
2. Ready-mixed concrete manufacturer.

B. Material Certificates: For each of the following, signed by manufacturers:

1. Cementitious materials.
2. Admixtures.
3. Curing compounds.

4. Bonding agents.
5. Adhesives.
6. Vapor retarders.
7. Semirigid joint filler.
8. Joint-filler strips.
9. Repair materials.

C. Material Test Reports: For the following, from a qualified testing agency:

1. Portland cement.
2. Fly ash.
3. Aggregates.
4. 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.

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 Flatwork Technician and Finisher and a supervisor who is a certified ACI Flatwork Concrete Finisher/Technician or an ACI Concrete Flatwork Technician.

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 certified in accordance with NRMCA's "Certification of Ready Mixed Concrete Production Facilities."

C. Laboratory Testing Agency Qualifications: A testing agency qualified in accordance with ASTM C1077 and ASTM E329 for testing indicated and employing an ACI-certified Concrete Quality Control Technical Manager.

1. Personnel performing laboratory tests shall be an ACI-certified Concrete Strength Testing Technician and Concrete Laboratory Testing Technician, Grade I. Testing agency

laboratory supervisor shall be an ACI-certified Concrete Laboratory Testing Technician, Grade II.

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. Personnel conducting field tests shall be qualified as an ACI Concrete Field Testing Technician, Grade 1, in accordance with ACI CPP 610.1 or an equivalent certification program.

E. Mockups: Cast concrete slab-on-ground and formed-surface panels to demonstrate typical joints, surface finish, texture, tolerances, floor treatments, and standard of workmanship. Provide up to two batches of concrete to demonstrate the number of required mockups.

1. Slab-On-Ground: Build panel approximately 15 feet by 15 feet in the location indicated or, if not indicated, as directed by Architect.

a. Divide panel into four equal panels to demonstrate saw joint cutting.

2. Formed Surfaces: Build panel in the location indicated or, if not indicated, as directed by Architect.
3. Board Formed Concrete: Build panel approximately 10 feet by 10 feet in the location as directed by Architect
4. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.7 PRECONSTRUCTION TESTING

A. Preconstruction Testing Service: Engage a qualified testing agency to perform preconstruction testing on each concrete mixture.

1. Include the following information in each test report:

a. Admixture dosage rates.
b. Slump.
c. Air content.
d. Seven-day compressive strength.
e. 28-day compressive strength.

1.8 DELIVERY, STORAGE, AND HANDLING

A. Comply with ASTM C94/C94M and ACI 301.

1.9 FIELD CONDITIONS

A. Cold-Weather Placement: Comply with ACI 301 and ACI 306.1 and 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 average high and low temperature is expected to fall below 40 deg F for three successive days, 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.
5. Do not use calcium chloride, salt, or other materials containing antifreeze agents or chemical accelerators unless otherwise specified and approved in mixture designs.

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.

1.10 GUARANTEE FOR ARCHITECTURAL CONCRETE WORK

A. Vapor Retarder 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.

B. Special Guarantee: On form approved by Architect, without monetary limitation, in which manufacturer agrees to promptly repair or replace all components of concrete that fail in materials or workmanship, including material and labor, within specified guarantee period.

1. Failures include pitting, spalling, cracking, honeycombing, surface color and texture irregularities, air bubbles, rock pockets, fins and other projections on the surface, and stains and other discolorations that cannot be removed by cleaning. Immediately repair or replace concrete and place in satisfactory condition in every particular, any guaranteed work upon written notice from the Project Manager or Architect and make good all damage to the buildings and grounds caused by said work, without cost to the Owner.
2. Warranty Period: 2 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 CONCRETE, GENERAL

A. ACI Publications: Comply with ACI 301unless 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 or class of cementitious material of the same brand from the same manufacturer's plant.
3. Obtain aggregate from single source.
4. Obtain each type of admixture from single source from single manufacturer.

B. Cementitious Materials:

1. Portland Cement: ASTM C150/C150M, Type I/II, gray.
2. Fly Ash: ASTM C618, Class F.

C. Normal-Weight Aggregates: ASTM C33/C33M, Class 3S coarse aggregate or better, graded. Provide aggregates from a single source.

1. Alkali-Silica Reaction: Comply with one of the following:

a. Expansion Result of Aggregate: Not more than 0.04 percent at one-year when tested in accordance with ASTM C1293.
b. Expansion Results of Aggregate and Cementitious Materials in Combination: Not more than 0.10 percent at an age of 16 days when tested in accordance with ASTM C1567.
c. Alkali Content in Concrete: Not more than 4 lb./cu. yd. for moderately reactive aggregate or 3 lb./cu. yd. for highly reactive aggregate, when tested in accordance with ASTM C1293 and categorized in accordance with ASTM C1778, based on alkali content being calculated in accordance with ACI 301.

2. Maximum Coarse-Aggregate Size: 3/4 inch nominal.
3. Fine Aggregate: Free of materials with deleterious reactivity to alkali in cement.

D. Air-Entraining Admixture: ASTM C260/C260M.

E. Chemical Admixtures: Certified by manufacturer to be compatible with other admixtures that do not contribute water-soluble chloride ions exceeding those permitted in hardened concrete. Do not use calcium chloride or admixtures containing calcium chloride in steel-reinforced concrete.

1. Water-Reducing Admixture: ASTM C494/C494M, Type A.
2. Retarding Admixture: ASTM C494/C494M, Type B.
3. High-Range, Water-Reducing Admixture: ASTM C494/C494M, Type F.
4. High-Range, Water-Reducing and -Retarding Admixture: ASTM C494/C494M, Type G.

F. Water and Water Used to Make Ice: ASTM C94/C94M, potable or complying with ASTM C1602/C1602M, including all limits listed in Table 2 and the requirements of paragraph 5.4

2.3 VAPOR RETARDERS

A. Sheet Vapor Retarder, Class A: ASTM E1745, Class A, except with maximum water-vapor permeance of 0.01; not less than 10 mils thick. Include manufacturer's recommended adhesive or pressure-sensitive tape.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Fortifiber Building Systems Group.
b. Raven Industries, Inc.
c. Reef Industries, Inc.
d. Stego Industries, LLC.
e. W.R. Meadows, Inc.

2.4 CURING MATERIALS

A. Membrane Curing:

1. Clear water-based, ready-to use membrane curing agent that cures freshly placed concrete, forming effective barrier against moisture loss from concrete surface.
2. Design Criteria:

a. Exterior Concrete:

1) Dissipating or non-dissipating membrane curing agent.

b. Interior Concrete:

1) Dissipating membrane curing agent only.
2) Gradually dissipate after twenty-eight (28) days without leaving stain or discoloring concrete surface.

c. VOC-compliant compound.
d. Meet requirements of ASTM C309 and AASHTO M 148, Type 1 or 1-D, Class B.
e. Interior concrete: containing no mineral spirits, naphtha, or other components detrimental to finish flooring installation.
f. Maintain ninety-five (95) percent of mix water present in concrete mass after application.

3. Horizontal and Vertical Cast-In-Place Structural Concrete:

a. Acceptable Products.

1) Exterior Concrete:

a) Clear Cure J7WB by Dayton Superior Corporation, Miamisburg. OH www.daytonsuperior.com.
b) Clear Water Resin by Right Point, Dekalb, IL www.rightpointe.com.

c) L&M Cure R by L&M Construction Chemicals, Inc. Omaha, NE www.Imcc.com.
d) VOCOMP 20 (do not use when concrete sealer will be applied in areas of freeze/thaw and deicer salts) by W.R. Meadows, Inc. Hampshire, IL www.wrmeadows.com.
e) 1100-Clear by W. R. Meadows, Inc. Hampshire, IL www.wrmeadows.com.
f) Equal as approved by Architect before use. See Section 01 67000

b. Interior Concrete:

a) Clear Cure J7WB by Dayton Superior Corporation, Miamisburg. OH www.daytonsuperior.com.
b) Clear Water Resin by Right Point, Dekalb, IL www.rightpointe.com.
c) L&M Cure R by L&M Construction Chemicals, Inc. Omaha, NE www.Imcc.com.
d) 1100-Clear by W. R. Meadows, Inc. Hampshire, IL www.wrmeadows.com.
e) Equal as approved by Architect before use. See Section 01 6000.

B. Water Curing:

1. Required Locations:

a. Use on polished concrete finishing surfaces in areas as shown on Contract Drawings.
b. Used on all interior concrete floor surfaces including offices that receive carpet.
c. Used on concrete surfaces in Process Area, Process Area Custodial Room, and Yard Sales Area only.
d. Used on concrete surfaces in areas as shown in Contract Documents.

2. Water-Curing Materials:

a. Type Two Acceptable Products:

1) Absorptive Cover: Meet requirements of AASHTO M 182, Class 2 burlap cloth made from jute or kenaf and weighing minimum of 9 oz per sq yd (305 grams per sq m) when dry.

b. Moisture-Retaining Cover: White, opaque membrane meeting requirements of ASTM C171 minimum.

1) Color:

a) Ambient Temperature Below 50 deg F: Black.
b) Ambient Temperature between 50 deg F and 85 deg F: Any color.
c) Ambient Temperature Above 85 deg F: White.

c. Equals as approved by Architect before using. See Section 01 6000.

C. Evaporation Retarder: Waterborne, monomolecular film forming, manufactured for application to fresh concrete.

1. Products: Subject to compliance with requirements, provide one of the following:

a. BASF Corporation; MasterKure ER 50.
b. ChemMasters, Inc; Spray-Film.
c. Dayton Superior; AquaFilm Concentrate J74.
d. Euclid Chemical Company (The); an RPM company; Eucobar.
e. Kaufman Products, Inc; VaporAid.
f. Lambert Corporation; Lambo Skin.
g. Laticrete International, Inc.; L&M E-CON.
h. Metalcrete Industries; Waterhold.
i. Nox-Crete Products Group; Monofilm.
j. Sika Corporation; SikaFilm.

D. Water: Potable or complying with ASTM C1602/C1602M.

2.5 RELATED MATERIALS

A. Expansion- and Isolation-Joint-Filler Strips: ASTM D1751, asphalt-saturated cellulosic fiber or ASTM D1752, cork or self-expanding cork.

B. Semirigid Joint Filler: Two-component, semirigid, 100 percent solids, aromatic polyurea with a Type A shore durometer hardness range of 90 to 95 in accordance with ASTM D2240.

C. Bonding Agent: ASTM C1059/C1059M, Type II, nonredispersible, acrylic emulsion or styrene butadiene.

D. Floor Slab Protective Covering: Eight-feet-wide cellulose fabric.

2.6 REPAIR MATERIALS

A. Repair Underlayment: Cement-based, polymer-modified, self-leveling product that can be applied in thicknesses from 1/8 inch and that can be feathered at edges to match adjacent floor elevations.

1. Cement Binder: ASTM C150/C150M portland cement or hydraulic or blended hydraulic cement, as defined in ASTM C219.
2. Primer: Product of underlayment manufacturer recommended for substrate, conditions, and application.
3. Aggregate: Well-graded, washed gravel, 1/8 to 1/4 inch or coarse sand, as recommended by underlayment manufacturer.
4. Compressive Strength: Not less than 4100 psi at 28 days when tested in accordance with ASTM C109/C109M.

B. Repair Overlayment: Cement-based, polymer-modified, self-leveling product that can be applied in thicknesses from 1/4 inch and that can be filled in over a scarified surface to match adjacent floor elevations.

1. Cement Binder: ASTM C150/C150M portland cement or hydraulic or blended hydraulic cement, as defined in ASTM C219.
2. Primer: Product of topping manufacturer recommended for substrate, conditions, and application.
3. Aggregate: Well-graded, washed gravel, 1/8 to 1/4 inch or coarse sand as recommended by topping manufacturer.
4. Compressive Strength: Not less than 5000 psi at 28 days when tested in accordance with ASTM C109/C109M.

2.7 CONCRETE MIXTURES, GENERAL

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 cement in concrete as follows:

1. Fly Ash: 25 percent by mass.

C. Admixtures: Use admixtures in accordance with manufacturer's written instructions.

1. Use water-reducing admixture in concrete, as required, for placement and workability.
2. Use water-reducing and -retarding admixture when required by high temperatures, low humidity, or other adverse placement conditions.
3. Use water-reducing admixture in pumped concrete, and concrete with a w/cm below 0.50.

2.8 CONCRETE MIXTURES

A. Class A: Normal-weight concrete used for footings.

1. Exposure Class: As indicated on Structural Notes in Structural Drawings.
2. Minimum Compressive Strength: As indicated on Structural Notes in Structural Drawings, minimum 3000 psi unless otherwise noted.
3. Maximum w/cm: 0.45 to 0.50.
4. Slump Limit: 4 inches, plus or minus 1 inch.
5. Limit water-soluble, chloride-ion content in hardened concrete to 1.00 percent by weight of cement.

B. Class B: Normal-weight concrete used for foundation walls.

1. Exposure Class: As indicated on Structural Notes in Structural Drawings.
2. Minimum Compressive Strength: As indicated on Structural Notes in Structural Drawings, minimum 4500 psi unless otherwise noted.
3. Maximum w/cm: 0.40 to 0.42.
4. Slump Limit: 4 inches, plus or minus 1 inch.
5. Limit water-soluble, chloride-ion content in hardened concrete to 1.00 percent by weight of cement.

C. Class C: Normal-weight concrete used for interior slabs-on-ground.

1. Exposure Class: ACI 318 As indicated on Structural Notes in Structural Drawings.
2. Minimum Compressive Strength: As indicated on Structural Notes in Structural Drawings.
3. Maximum w/cm: 0.50.
4. Slump Limit: 4 inches, plus or minus 1 inch.
5. Air Content:

    a. Do not use an air-entraining admixture or allow total air content to exceed 3 percent for concrete used in trowel-finished floors.

6. Limit water-soluble, chloride-ion content in hardened concrete to 1.00 percent by weight of cement.

D. Class J: Normal-weight concrete used for exterior retaining walls and exterior slabs on grade.

1. Exposure Class: ACI 318 As indicated on Structural Notes in Structural Drawings.
2. Minimum Compressive Strength: As indicated on Structural Notes in Structural Drawings at 28 days, minimum 4500 psi unless otherwise noted.
3. Maximum w/cm Ratio: 0.40 to 0.42.
4. Slump Limit: 4 inches, plus or minus 1 inch for concrete.
5. Air Content:

    a. Exposure Classes F2: 6.0 percent, plus or minus 1.5 percent at point of delivery for concrete containing 1-inch nominal maximum aggregate size.

6. Limit water-soluble, chloride-ion content in hardened concrete to 1.0 percent by weight of cement.

2.9 CONCRETE MIXING

A. Ready-Mixed Concrete: Measure, batch, mix, and deliver concrete in accordance with ASTM C94/C94M and ASTM C1116/C1116M, and furnish batch ticket information.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verification of Conditions:

1. Before placing concrete, verify that installation of concrete forms, accessories, and reinforcement, and embedded items is complete and that required inspections have been performed.
2. Do not proceed until unsatisfactory conditions have been corrected.

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 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 anchor rods, accurately located, to elevations required and complying with tolerances in Section 7.5 of ANSI/AISC 303.

3.4 INSTALLATION OF VAPOR RETARDER

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, sealing entire perimeter to floor slabs or foundation walls.

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.

3.5 CONCRETE PLACEMENT

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. Do not add water to concrete during delivery, at Project site, or during placement unless approved by Architect in writing, but not to exceed the amount indicated on the concrete delivery ticket.

1. Do not add water to concrete after adding high-range water-reducing admixtures to mixture.

D. Before test sampling and placing concrete, water may be added at Project site, subject to limitations of ACI 301, but not to exceed the amount indicated on the concrete delivery ticket.

1. Do not add water to concrete after adding high-range water-reducing admixtures to mixture.

E. 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.

F. 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.

3.6 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.
b. Do not continue reinforcement through sides of strip placements of floors and slabs.

3. 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.
4. Locate horizontal joints in walls and columns at underside of floors, slabs, beams, and girders and at the top of footings or floor slabs.
5. Use a bonding agent 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 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 07 9200 "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.

3.7 FINISHING FORMED SURFACES

A. As-Cast Surface Finishes:

1. ACI 301 Surface Finish SF-1.0: As-cast concrete texture imparted by form-facing material.

a. Patch voids larger than 1-1/2 inches wide or 1/2 inch deep.
b. Remove projections larger than 1 inch.
c. Tie holes do not require patching.
d. Surface Tolerance: ACI 117 Class D.
e. Apply to concrete surfaces not exposed to public view.

2. ACI 301Surface Finish SF-2.0: As-cast concrete texture imparted by board 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 and covered with a parge coat coating applied directly to concrete.

3. ACI 301 (ACI 301M) Surface Finish SF-3.0: As-cast concrete, same as Surface Finish SF-2.0, except also complying with requirements of Architectural Concrete.

a. Patch voids larger than 3/4 inch wide or 1/2 inch deep.
b. Remove projections larger than 1/8 inch.
c. Patch tie holes.
d. Surface Tolerance: ACI 117 Class A.
e. Locations: Apply to concrete surfaces exposed to public view, Architectural Concrete.

B. Board Form Form-Liner Finish. Produce a textured surface free of pockets, streaks, and honeycombs, and of uniform appearance, color, and texture. Apply where indicated.

C. Related Unformed Surfaces:

1. At tops of horizontal offsets, and similar unformed surfaces adjacent to formed surfaces, strike off smooth and finish with a color and texture matching adjacent formed surfaces.
2. Continue final surface treatment of formed surfaces uniformly across adjacent unformed surfaces unless otherwise indicated.

3.8 FINISHING FLOORS AND SLABS

A. Comply with ACI 302.1R recommendations for screeding, restraightening, and finishing operations for concrete surfaces. Do not wet concrete surfaces.

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 and to be covered with fluid-applied or sheet waterproofing, built-up or membrane roofing, or sand-bed terrazzo.

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.
5. Do not apply hard-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 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, F_F 25; and of levelness, F_L 20; with minimum local values of flatness, F_F 17; and of levelness, F_L 15.

D. 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 fiber-bristle broom perpendicular to main traffic route.
2. Coordinate required final finish with Architect before application.

3.9 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 blend with in-place construction.
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 steel-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.

3.10 CONCRETE CURING

A. Protect freshly placed concrete from premature drying and excessive cold or hot temperatures.

1. Comply with ACI 301 and ACI 306.1 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 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 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 immediately 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:

a) Water.
b) Continuous water-fog spray.

b. 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 unless manufacturer certifies curing compound does not interfere with bonding of floor covering used on Project.

3.11 TOLERANCES

A. Conform to ACI 117.

3.12 JOINT FILLING

A. Prepare, clean, and install joint filler in accordance with manufacturer's written instructions.

1. Defer joint filling until concrete has aged at least one month(s).
2. Do not fill joints until construction traffic has permanently ceased.

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 WATERSTOPS

A. Provide waterstops where indicated on drawings and at joints where water intrusion is possible (Contractor option);

1. Waterstops: PVC, complying with COE CRD-C 572.

    a. Configuration: As indicated on drawings.
    b. Size: As indicated on drawings.
    c. Manufacturers: As approved by Architect before use. See Section 01 6000.

2. Waterstops: Bentonite and butyl rubber, complying with NSF 61 and NSF 372.

    a. Configuration: As indicated on drawings.
    b. Size: As indicated on drawings.
    c. Manufacturers: As approved by Architect before use. See Section 01 6000.

3.14 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 Architect's approval.

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, spalls, air bubbles, honeycombs, rock pockets, fins and other projections on the surface, and stains and other discolorations that cannot be removed by cleaning.

1. Immediately after form removal, 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 strike off slightly higher than 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, and other objectionable conditions.
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 cutting out low areas and replacing with 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 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. Remove and replace cast-in-place board formed concrete that cannot be repaired to Architect's approval.

G. Repair materials and installation not specified above may be used, subject to Architect's approval.

3.15 FIELD QUALITY CONTROL

A. Special Inspections: Owner will engage a special inspector to perform field tests and inspections and prepare testing and inspection reports.

1. Testing agency shall be responsible for providing curing container for composite samples on Site and verifying that field-cured composite samples are cured in accordance with ASTM C31/C31M.
2. Testing agency shall immediately report to Architect, Contractor, and concrete manufacturer any failure of Work to comply with Contract Documents.
3. Testing agency shall 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 shall 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.
9) Truck and batch ticket numbers.
10) Design compressive strength at 28 days.
11) Concrete mixture designation, proportions, and materials.
12) Field test results.
13) Information on storage and curing of samples before testing, 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.

B. Batch Tickets: For each load delivered, submit three copies of batch delivery ticket to testing agency, indicating quantity, mix identification, admixtures, design strength, aggregate size,

design air content, design slump at time of batching, and amount of water that can be added at Project site.

C. 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.

D. Concrete Tests: Testing of composite samples of fresh concrete obtained in accordance with ASTM C 172/C 172M shall 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 50 cu. yd. or fraction thereof.

    a. When frequency of testing provides fewer than five compressive-strength tests for each concrete mixture, testing shall be conducted from at least five randomly selected batches or from each batch if fewer than five are used.

2. Slump: ASTM C143/C143M:

    a. One test at point of placement for each composite sample, but not less than one test for each day's pour of each concrete mixture.
    b. Perform additional tests when concrete consistency appears to change.

3. Air Content: ASTM C231/C231M pressure method, for normal-weight concrete;.

    a. One test for each composite sample, 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.

5. Compression Test Specimens: ASTM C31/C31M:

    a. Cast and laboratory cure two sets of three 6-inch by 12-inch or 4-inch by 8-inch cylinder specimens for each composite sample.
    b. Cast, initial cure, and field cure two sets of three standard cylinder specimens for each composite sample.

6. Compressive-Strength Tests: ASTM C39/C39M.

a. Test one set of three laboratory-cured specimens at seven days and one set of two specimens at 28 days.
b. Test one set of three field-cured specimens at seven days and one set of two specimens at 28 days.
c. A compressive-strength test shall be the average compressive strength from a set of two specimens obtained from same composite sample and tested at age indicated.

7. When strength of field-cured cylinders is less than 85 percent of companion laboratory-cured cylinders, Contractor shall evaluate operations and provide corrective procedures for protecting and curing in-place concrete.
8. Strength of each concrete mixture will be satisfactory if every average of any three consecutive compressive-strength tests equals or exceeds specified compressive strength, and no compressive-strength test value falls below specified compressive strength by more than 500 psi 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.
9. 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.
10. Additional Tests:

a. Testing and inspecting agency shall make additional tests of concrete when test results indicate that slump, air entrainment, compressive strengths, or other requirements have not been met, as directed by Architect.
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 shall be in accordance with ACI 301 section 1.6.6.3.

11. Additional testing and inspecting, at Contractor's expense, will be performed to determine compliance of replaced or additional work with specified requirements.
12. Correct deficiencies in the Work that test reports and inspections indicate do not comply with the Contract Documents.

E. Measure floor and slab flatness and levelness in accordance with ASTM E1155 within 24 hours of completion of floor finishing and promptly report test results to Architect.

3.16 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.

3.17 FINAL ACCEPTANCE

A. Final acceptance of completed board-form concrete Work will be determined by Architect by comparing approved field sample panels mockups with installed Work, when viewed at a distance of 20 feet.

END OF SECTION 03 3000

SECTION 04 4314 - ADHERED STONE MASONRY VENEER

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Stone masonry adhered to wood framing and sheathing.

1.2 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1.3 ACTION SUBMITTALS

A. Product Data: For each variety of stone, stone accessory, and manufactured product.

B. Samples for Verification:

1. For each stone type indicated. Include at least three Samples in each set, and show the full range of color and other visual characteristics in completed Work.
2. For each color of mortar required. Label Samples to indicate types and amounts of pigments used.

1.4 INFORMATIONAL SUBMITTALS

A. Qualification Data: For Installer.

B. List of Materials Used in Constructing Mockups: List generic product names together with manufacturers, manufacturers' product names, supply sources, and other information as required to identify materials used. Include mix proportions for mortar and source of aggregates.

1. Neither receipt of list nor approval of mockups constitutes approval of deviations from the Contract Documents contained in mockups unless Architect approves such deviations in writing.

C. Material Test Reports:

1. Stone Test Reports: For stone variety proposed for use on Project, by a qualified testing agency, indicating compliance with required physical properties, other than abrasion resistance, according to referenced ASTM standards. Base reports on testing done within previous five years.

2. Sealant Compatibility and Adhesion Test Report: From sealant manufacturer, indicating that sealants will not stain or damage stone. Include interpretation of test results and recommendations for primers and substrate preparation needed for adhesion.

1.5 QUALITY ASSURANCE

A. Installer Qualifications: A qualified installer who employs experienced stonemasons and stone fitters.

B. Mockups: Build mockups to demonstrate aesthetic effects and to set quality standards for materials and execution.

1. Build mockups for typical exterior wall in sizes approximately 48 inches long by 48 inches high by full thickness, including face and backup construction and accessories.

   a. Include through-wall flashing installed for a 24-inch length in corner of mockup approximately 16 inches down from top of mockup, with a 12-inch length of flashing left exposed to view (omit stone masonry above half of flashing).
   b. Include wood studs, sheathing, building paper or wrap, drainage material, and flashing in exterior masonry-veneer wall mockup.

2. Protect accepted mockups from the elements with weather-resistant membrane.
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.

1.6 PRECONSTRUCTION TESTING

A. Preconstruction Sealant Compatibility and Adhesion Testing: Submit to joint-sealant manufacturers, for compatibility and adhesion testing according to sealant manufacturer's standard testing methods and Section 07 9200 "Joint Sealants," Samples of materials that will contact or affect joint sealants.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Store cementitious materials on elevated platforms, under cover, and in a dry location. Do not use cementitious materials that have become damp.

B. Store aggregates where grading and other required characteristics can be maintained and contamination avoided.

C. Deliver preblended, dry mortar mix in moisture-resistant containers designed for use with dispensing silos. Store preblended, dry mortar mix in delivery containers on elevated platforms, under cover, in a dry location, or in covered weatherproof dispensing silos.

1.8 FIELD CONDITIONS

A. Protection of Stone Masonry: During construction, cover tops of walls, projections, and sills with waterproof sheeting at end of each day's work. Cover partially completed stone masonry when construction is not in progress.

1. Extend cover a minimum of 24 inches down both sides, and hold cover securely in place.

B. Stain Prevention: Immediately remove mortar and soil to prevent them from staining stone masonry face.

1. Protect base of walls from rain-splashed mud and mortar splatter, using coverings spread on the ground and over the 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 end of each day to prevent rain from splashing mortar and dirt on completed stone 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 stone masonry damaged by frost or freezing conditions. Comply with cold-weather construction requirements contained in TMS 602/ACI 530.1/ASCE 6.

1. Cold-Weather Cleaning: Use liquid cleaning methods only when air temperature is 40 deg F and above 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 602/ACI 530.1/ASCE 6.

1.9 COORDINATION

A. Advise installers of other work about specific requirements for placement of flashing and similar items to be built into stone masonry.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Source Limitations for Stone: Obtain stone, regardless of finish, from single quarry with resources to provide materials of consistent quality in appearance and physical properties.

B. Source Limitations for Mortar Materials: Obtain mortar ingredients of uniform quality for each cementitious component from single manufacturer and each aggregate from single source or producer.

2.2 SLATE

A. Varieties and Sources: Item E1 on Exterior Finish Schedule. Subject to compliance with requirements, provide the following:

1. Delta Stone: Jackson Ledge.

a. Thickness: 3 to 6 inches.
b. Colors: Variety, including black, blue gray, brown, gold and rose.

B. Match Architect's samples for color, finish, and other stone characteristics relating to aesthetic effects.

2.3 MORTAR MATERIALS

A. Portland Cement: ASTM C150/C150M, Type I or Type II, except Type III may be used for cold-weather construction; natural color or white cement may be used as required to produce mortar color indicated.

1. Low-Alkali Cement: Not more than 0.60 percent total alkali when tested according to 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.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Essroc.
b. Holcim (US) Inc.
c. Lafarge North America Inc.

D. Aggregate: ASTM C144 and as follows:

1. For pointing mortar, use aggregate graded with 100 percent passing No. 16 sieve.
2. White Aggregates: Natural white sand or ground white stone.

E. Latex Additive: Manufacturer's standard acrylic-resin or styrene-butadiene-rubber water emulsion, serving as replacement for part or all of gaging water, of type specifically recommended by latex-additive manufacturer for use with field-mixed portland cement mortar bed, and not containing a retarder.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Custom Building Products.
b. Laticrete International, Inc.

c. MAPEI Corporation.

F. Water: Potable.

2.4 STONE TRIM ANCHORS

A. Stone Trim Anchors: Units fabricated with tabs or dowels designed to engage kerfs or holes in stone trim units and holes for fasteners or postinstalled anchor bolts for fastening to substrates or framing as indicated.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Heckmann Building Products, Inc.
b. Hohmann & Barnard, Inc.

B. Materials: Fabricate anchors from stainless steel, ASTM A240/A240M or ASTM A666, Type 304. Fabricate dowels from stainless steel, ASTM A276, Type 304.

C. Fasteners for Stone Trim Anchors: Annealed stainless steel bolts, nuts, and washers; ASTM F593 for bolts and ASTM F594 for nuts, Alloy Group 1.

D. Postinstalled Anchor Bolts for Fastening Stone Trim Anchors: Torque-controlled expansion anchors or undercut anchors made from stainless steel components, complying with ASTM F593 and ASTM F594, Alloy Group 1 or 2 for bolts and nuts; ASTM A666 or ASTM A276, Type 304 or Type 316, for anchors.

2.5 EMBEDDED FLASHING MATERIALS

A. Metal Flashing: Provide metal flashing, where flashing is exposed or partly exposed and where indicated, complying with SMACNA's "Architectural Sheet Metal Manual" and as follows:

1. Stainless Steel: ASTM A240/A240M, Type 304, 0.016 inch thick.
2. Fabricate continuous flashings in sections 96 inches long minimum, but not exceeding 12 feet. Provide splice plates at joints of formed, smooth metal flashing.
3. 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.

a. Products: Subject to compliance with requirements, provide one of the following:

1) Cheney Flashing Company; Cheney 3-Way Flashing (Sawtooth) or Cheney Flashing (Dovetail).
2) Hohmann & Barnard, Inc; MFL-STF Metal Sawtooth Flashing.
3) Keystone Flashing Company, Inc; Keystone 3-Way Interlocking Thruwall Flashing.

4. Fabricate through-wall flashing with drip edge where indicated. Fabricate by extending flashing 1/2 inch out from wall, with outer edge bent down 30 degrees and hemmed.

5. 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 will shed water.

B. Self-Adhering Flexible Metal Flashing: Provide self-adhering flexible metal flashing, as follows:

1. Self-Adhering Stainless Steel: ASTM A240/A240M or ASTM A666, Type 304, stainless steel with inward facing butyl block co-polymer adhesive.

a. Products: Provide one of the following:

1) York Manufacturing, Inc.; York 304 SS
2) TK Products, Inc.; TK Self-Adhering Stainless Steel TWF
3) Vapro Shield, Inc.; VaproThru-Wall Flashing SA

b. Sealant for Self-Adhering Stainless Steel:

1) One part 100 percent solids, solvent-free formulated silyl-terminated polyether (STPE), ASTM C920-11, Type S, Grade NS, Class 50.

a) York Manufacturing, Inc.; UniverSeal US100.
b) STS Coatings; GreatSeal LT-100.
c) Prosoco, Inc.; R-Guard Joint Seam Sealer.

C. Application: Unless otherwise indicated, use the following:

1. Where flashing is indicated to be turned down at or beyond wall face, use metal flashing.
2. Where flashing is partly exposed and is indicated to terminate at wall face, use metal flashing with a drip edge.
3. Where flashing is fully concealed, use flexible metal flashing.

D. Solder and Sealants for Sheet Metal Flashings: As specified in Section 07 6200 "Sheet Metal Flashing and Trim."

1. Solder for Stainless Steel: ASTM B32, Grade Sn60, with acid flux of type recommended by stainless steel sheet manufacturer.

E. Adhesives, Primers, and Seam Tapes for Flexible Flashings: Flashing manufacturer's standard products or products recommended by flashing manufacturer for bonding flashing sheets to each other and to substrates.

2.6 MISCELLANEOUS MASONRY 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 or PVC.

B. Weep Products: Use the following unless otherwise indicated:

1. Mesh Weep Holes: Free-draining mesh; made from polyethylene strands, full width of head joint and 2 inches high by thickness of stone masonry; in color selected from manufacturer's standard.

a. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1) CavClear; a division of Archovations, Inc.
2) Mortar Net Solutions.

C. 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.

D. Lath Attachment Devices: Material and type required by ASTM C1063 for installations indicated.

2.7 MASONRY CLEANERS

A. Proprietary Acidic Cleaner: Manufacturer's standard-strength cleaner designed for removing mortar and grout stains, efflorescence, and other new construction stains from stone masonry surfaces without discoloring or damaging masonry surfaces; expressly approved for intended use by cleaner manufacturer and stone producer.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Diedrich Technologies, Inc.; a Hohmann & Barnard company.
b. Hydroclean; Hydrochemical Techniques, Inc.
c. Laticrete International, Inc.
d. PROSOCO, Inc.

2.8 FABRICATION

A. General: Fabricate stone units in sizes and shapes required to comply with requirements indicated.

B. Cut stone to produce pieces of thickness, size, and shape indicated, including details on Drawings and pattern specified in "Setting Stone Masonry" Article.

C. Dress joints (bed and vertical) straight and at right angle to face unless otherwise indicated. Shape beds to fit supports.

D. Carefully inspect stone at quarry or fabrication plant for compliance with requirements for appearance, material, and fabrication. Replace defective units before shipment.

1. Clean sawed backs of stone to remove rust stains and iron particles.

E. Thickness of Stone: Provide thickness indicated, but not less than the following:

1. Thickness: 3 to 6 inches, as standard with product specified.

F. Finish exposed stone faces and edges to comply with requirements indicated for finish and to match approved samples and mockups.

1. Finish: As standard with Manufacturer for thin stone product specified.

2.9 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.
2. Use portland cement-lime mortar unless otherwise indicated.
3. Mixing Pointing Mortar: Thoroughly mix cementitious and aggregate materials together before adding water. Then mix again, adding only enough water to produce a damp, unworkable mix that will retain its form when pressed into a ball. Maintain mortar in this dampened condition for one to two hours. Add remaining water in small portions until mortar reaches required consistency. Use mortar within 30 minutes of final mixing; do not retemper or use partially hardened material.

B. Preblended, Dry Mortar Mix: Furnish dry mortar ingredients in the 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 Stone Masonry: Comply with ASTM C270, Property Specification.

1. Mortar for Setting Stone: Type S.
2. Mortar for Pointing Stone: Type N.

D. Latex-Modified Portland Cement Setting Mortar: Proportion and mix portland cement, aggregate, and latex additive to comply with latex-additive manufacturer's written instructions.

E. Mortar for Scratch Coat over Metal Lath: 1 part portland cement, 1/2 part lime, 5 parts loose damp sand, and enough water to produce a workable consistency.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine surfaces indicated to receive stone masonry, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of stone masonry.

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

3.2 PREPARATION

A. Clean dirty or stained stone surfaces by removing soil, stains, and foreign materials before setting. Clean stone by thoroughly scrubbing with fiber brushes and then drenching with clear water. Use only mild cleaning compounds that contain no caustic or harsh materials or abrasives.

3.3 SETTING STONE MASONRY

A. Perform necessary field cutting and trimming as stone is set.

1. Use power saws to cut stone that is fabricated with saw-cut surfaces. Cut lines straight and true, with edges eased slightly to prevent snipping.

B. Sort stone before it is placed in wall to remove stone that does not comply with requirements relating to aesthetic effects, physical properties, or fabrication, or that is otherwise unsuitable for intended use.

C. Arrange stones in range ashlar pattern with course heights as indicated, random lengths, and uniform joint widths, with offset between vertical joints as indicated.

D. Arrange stones with color and size variations uniformly dispersed for an evenly blended appearance.

E. Set stone to comply with requirements indicated on Drawings. Install supports, fasteners, and other attachments indicated or necessary to secure stone masonry in place. Set stone accurately in locations indicated, with edges and faces aligned according to established relationships and indicated tolerances.

F. Maintain uniform joint widths, except for variations due to different stone sizes and where minor variations are required to maintain bond alignment if any. Lay walls with joints not less than 1/4 inch at narrowest points or more than 1/2 inch at widest points.

G. Provide sealant joints of widths and at locations indicated.

1. Keep sealant joints free of mortar and other rigid materials.
2. Sealing joints are specified in Section 07 9200 "Joint Sealants."

H. Install embedded flashing and weep holes at shelf angles, lintels, ledges, other obstructions to downward flow of water in wall, and where indicated.

1. At stud-framed walls, extend flashing through stone masonry, up sheathing face at least 16 inches, and behind weather barrier.
2. At lintels and shelf angles, extend flashing full length of angles but not less than 6 inches into masonry at each end.
3. At sills, extend flashing not less than 4 inches at ends.

4. At ends of head and sill flashing, turn up not less than 2 inches to form end dams.
5. 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 07 9200 "Joint Sealants" for application indicated.
6. 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 07 9200 "Joint Sealants" for application indicated.
7. Extend sheet metal flashing 1/2 inch beyond masonry face at exterior, and turn flashing down to form a drip.
8. Cut flexible flashing flush with wall face after completing masonry wall construction.

I. Place weep holes in joints where moisture may accumulate, including above shelf angles and at flashing.

1. Use mesh weep holes or open head joints to form weep holes.
2. Space weep holes 16 inches o.c.

3.4 CONSTRUCTION TOLERANCES

A. Variation from Plumb: For vertical lines and surfaces, do not exceed 1/4 inch in 10 feet, 3/8 inch in 20 feet, or 1/2 inch in 40 feet or more. For external corners, expansion joints, control joints, and other conspicuous lines, do not exceed 1/4 inch in 20 feet or 1/2 inch in 40 feet or more.

B. Variation from Level: For bed joints and lines of exposed lintels, sills, parapets, horizontal grooves, and other conspicuous lines, do not exceed 1/4 inch in 20 feet or 1/2 inch in 40 feet or more.

C. Variation of Linear Building Line: For position shown in plan, do not exceed 1/2 inch in 20 feet or 3/4 inch in 40 feet or more.

D. Measure variation from level, plumb, and position shown in plan as a variation of the average plane of each stone face from level, plumb, or dimensioned plane.

E. Variation in Mortar-Joint Thickness: Do not vary from joint size range indicated.

F. Variation in Plane between Adjacent Stones: Do not exceed one-half of tolerance specified for thickness of stone.

3.5 INSTALLATION OF ADHERED STONE MASONRY VENEER

A. Install flashing over sheathing and behind building wrap or air barrier by fastening through sheathing into framing.

1. Thorughly seal all penetrations in building wrap or air barrier, with materials and method recommended by Manufacturer.

B. Install lath over building paper or wrap by fastening through sheathing into framing to comply with ASTM C1063.

C. Install scratch coat over metal lath 3/8 inch thick to comply with ASTM C926.

D. Rake out joints for pointing with mortar to depth of not less than 1/2 inch before setting mortar has hardened. Rake joints to uniform depths with square bottoms and clean sides.

3.6 POINTING

A. Prepare stone-joint surfaces for pointing with mortar by removing dust and mortar particles. Where setting mortar was removed to depths greater than surrounding areas, apply pointing mortar in layers not more than 3/8 inch deep until a uniform depth is formed.

B. Point stone joints by placing and compacting pointing mortar in layers of not more than 3/8 inch deep. Compact each layer thoroughly, and allow to it become thumbprint hard before applying next layer.

C. Tool joints, when pointing mortar is thumbprint hard, with a smooth jointing tool to produce the following joint profile:

1. Joint Profile: Concave.

3.7 ADJUSTING AND CLEANING

A. Remove and replace stone masonry of the following description:

1. Broken, chipped, stained, or otherwise damaged stone. Stone may be repaired if methods and results are approved by Architect.
2. Defective joints.
3. Stone masonry not matching approved samples and mockups.
4. Stone masonry not complying with other requirements indicated.

B. Replace in a manner that results in stone masonry matching approved samples and mockups, complying with other requirements, and showing no evidence of replacement.

C. In-Progress Cleaning: Clean stone masonry as work progresses. Remove mortar fins and smears before tooling joints.

D. Final Cleaning: After mortar is thoroughly set and cured, clean stone masonry as follows:

1. Remove large mortar particles by hand with wooden paddles and nonmetallic scrape hoes or chisels.
2. Test cleaning methods on mockup; leave one-half of panel uncleaned for comparison purposes. Obtain Architect's approval of sample cleaning before cleaning stone masonry.
3. Protect adjacent stone and nonmasonry surfaces from contact with cleaner by covering them with liquid strippable masking agent, polyethylene film, or waterproof masking tape.

4. Wet wall surfaces with water before applying cleaner; remove cleaner promptly by rinsing thoroughly with clear water.
5. Clean stone masonry by bucket and brush hand-cleaning method described in BIA Technical Note No. 20, Revised II, using job-mixed detergent solution.

3.8 EXCESS MATERIALS AND WASTE

A. Excess Stone: Stack excess stone where directed by Owner for Owner's use.

B. Excess Masonry Waste: Remove excess clean masonry waste that cannot be used as fill, as described above, and other waste, and legally dispose of off Owner's property.

END OF SECTION 04 4314

SECTION 05 1200 - STRUCTURAL STEEL FRAMING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Structural steel.
2. Shear stud connectors.
3. Shrinkage-resistant grout.

B. Related Requirements:

1. Section 05 5000 "Metal Fabrications" for miscellaneous steel fabrications and other steel items not defined as structural steel.
2. Section 09 9123 "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. 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:

1. Structural-steel materials.
2. High-strength, bolt-nut-washer assemblies.
3. Shear stud connectors.
4. Anchor rods.
5. Threaded rods.
6. Shop primer.
7. Shrinkage-resistant grout.

B. Shop Drawings: Show fabrication of structural-steel components.

1. Include details of cuts, connections, splices, camber, holes, and other pertinent data.
2. Include embedment Drawings.
3. Indicate welds by standard AWS symbols, distinguishing between shop and field welds, and show size, length, and type of each weld. Show backing bars that are to be removed and supplemental fillet welds where backing bars are to remain.
4. Indicate type, size, and length of bolts, distinguishing between shop and field bolts. Identify pretensioned and slip-critical, high-strength bolted connections.
5. Identify demand-critical welds.
6. 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 whether prequalified or qualified by testing, including the following:

1. Power source (constant current or constant voltage).
2. Electrode manufacturer and trade name, for demand-critical welds.

1.6 INFORMATIONAL SUBMITTALS

A. Qualification Data: For Installer, fabricator, and shop-painting applicators.

B. Welding certificates.

C. Paint Compatibility Certificates: From manufacturers of topcoats applied over shop primers, certifying that shop primers are compatible with topcoats.

D. Mill test reports for structural-steel materials, including chemical and physical properties.

E. 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.

F. Source quality-control reports.

G. Field quality-control reports.

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).

A. Installer Qualifications: A qualified installer who complies with the AISC Quality Certification Program (or Equal) and is designated an AISC-Certified Erector (or Equal), Category ACSE or Category CSE (or Equal).

1. Installers that are not AISC certified shall provide documentation, prior to bid, showing an equal level of certification and a list of recent projects of similar size and type. A list of approved alternate-AISC installers will be issued to the bidding Contractors by Addenda.

B. Shop-Painting Applicators: Qualified in accordance with AISC's Sophisticated Paint Endorsement P1 or to SSPC-QP 3.

C. 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 shall pass the supplemental welder qualification testing, as required by AWS D1.8/D1.8M. FCAW-S and FCAW-G shall 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 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. Connection Design Information:

1. Option 1: Connection designs have been completed and connections indicated on the Drawings.

2.2 STRUCTURAL-STEEL MATERIALS

A. W-Shapes and Tees: ASTM A992/A992M.

B. Rolled Steel Structural Shapes: ASTM A992/A992M.

C. Channels, Angles, M-Shapes: ASTM A36/A36M.

D. Plate and Bar: ASTM A36/A36M.

E. Cold-Formed Hollow Structural Sections: ASTM A500/A500M, Grade B structural tubing.

F. Pipe: ASTM A53/A53M, Grade B, Finish black.

G. Steel Castings: ASTM A216/A216M, Grade WCB, with supplementary requirement S11.

H. Steel Forgings: ASTM A668/A668M.

I. Welding Electrodes: Comply with AWS requirements.

2.3 BOLTS AND CONNECTORS

A. At steel connections, high-Strength A325 Bolts, Nuts, and Washers: ASTM F3125/F3125M, Grade A325, Type 1, heavy-hex steel structural bolts; ASTM A563, Grade DH, heavy-hex carbon-steel nuts; and ASTM F436/F436M, Type 1, hardened carbon-steel washers; all with plain finish.

B. At steel to wood connections, Carbon steel, ASTM A307, Grade A and galvanized in compliance with ASTM A153/A153M Class C

C. 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.

2.4 RODS

A. Headed Anchor Rods (typical): ASTM F1554, Grade 36, straight.

1. Nuts: ASTM A563 heavy-hex carbon steel.
2. Plate Washers: ASTM A36/A36M carbon steel.
3. Washers: ASTM F436, Type 1, hardened carbon steel.
4. Finish: Plain.

B. Headed SFRS Anchor Rods (moment/braced): ASTM F1554, Grade 55, weldable, straight.

1. Nuts: ASTM A563 heavy-hex carbon steel.
2. Plate Washers: ASTM A36/A36M carbon steel.
3. Washers: ASTM F436, Type 1, hardened carbon steel.
4. Finish: Plain.

2.5 PRIMER

A. Steel Primer:

1. Comply with Section 09 9123 "Interior Painting."

2.6 SHRINKAGE-RESISTANT GROUT

A. 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.

1. Minimum Compressive Strength at 48 Hours: 2,000 pounds per square inch.
2. Minimum Compressive Strength at 28 Days: 7,000 pounds per square inch.
3. Height Change, Plastic State; when tested according to ASTM C827/C827M:

a. Maximum: Plus 4 percent.
b. Minimum: Plus 1 percent.

2.7 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.

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 3.

F. 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.
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.

2.8 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 or pretensioned as indicated.

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.

2.9 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.

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 3.

C. 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.

2.10 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 and test 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 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

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. Snug-tighten or pretension anchor rods as indicated after supported members have been positioned and plumbed. Do not remove wedges or shims but, if protruding, cut off flush with edge of plate before packing with grout.
4. Promptly pack 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 unless approved by Architect. Finish thermally cut sections within smoothness limits in AWS D1.1/D1.1M.

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 Pretensioned, as indicated in structural drawings.

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, 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.

3.5 REPAIR

A. Touchup Priming: Cleaning and touchup priming are specified in Section 09 9123 "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 and test 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.

END OF SECTION 05 1200

SECTION 05 5000 - METAL FABRICATIONS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Steel framing and supports for mechanical and electrical equipment.
2. Steel framing and supports for applications where framing and supports are not specified in other Sections.
3. Slotted channel framing.
4. Metal ladders.
5. Metal bollards.
6. Loose bearing and leveling plates for applications where they are not specified in other Sections.

B. Products furnished, but not installed, under this Section include the following:

1. Loose steel lintels.
2. Anchor bolts, steel pipe sleeves, slotted-channel inserts, and wedge-type inserts indicated to be cast into concrete or built into unit masonry.

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 the following:

1. Nonslip aggregates and nonslip-aggregate surface finishes.
2. Fasteners.
3. Shop primers.
4. Shrinkage-resisting grout.
5. Slotted channel framing.
6. Manufactured metal ladders.
7. Metal bollards.

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 Shop Drawings for the following:

1. Steel framing and supports for mechanical and electrical equipment.
2. Steel framing and supports for applications where framing and supports are not specified in other Sections.
3. Metal ladders.
4. Metal bollards.

C. Delegated-Design Submittal: For ladders, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

1.4 INFORMATIONAL SUBMITTALS

A. Qualification Data: 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.

B. Welding certificates.

C. Paint Compatibility Certificates: From manufacturers of topcoats applied over shop primers, certifying that shop primers are compatible with topcoats.

D. Research Reports: For post-installed anchors.

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."

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 01 4000 "Quality Requirements," to design ladders.

B. Thermal Movements: Allow for thermal movements from ambient and surface temperature changes acting on exterior metal fabrications 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

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.

C. Steel Tubing: ASTM A500/A500M, cold-formed steel tubing.

D. Steel Pipe: ASTM A53/A53M, Standard Weight (Schedule 40) unless otherwise indicated.

E. Slotted Channel Framing: Cold-formed metal box channels (struts) complying with MFMA-4.

1. Size of Channels: 1-5/8 by 1-5/8 inches.
2. Material: Galvanized steel, ASTM A653/A653M, commercial steel, Type B, with G90 coating; 0.108-inch nominal thickness.

F. Cast Iron: Either gray iron, ASTM A48/A48M, or malleable iron, ASTM A47/A47M, unless otherwise indicated.

2.3 FASTENERS

A. General: Unless otherwise indicated, provide Type 304 stainless steel fasteners for exterior use and zinc-plated fasteners with coating complying with ASTM B633 or ASTM F1941/F1941M, Class Fe/Zn 5, at exterior walls. Select fasteners for type, grade, and class required.

1. Provide stainless steel fasteners for fastening nickel silver.

B. Steel Bolts and Nuts: Regular hexagon-head bolts, ASTM A307, Grade A; with hex nuts, ASTM A563; and, where indicated, flat washers.

C. 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. 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 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.

I. Slotted-Channel Inserts: Cold-formed, hot-dip galvanized-steel box channels (struts) complying with MFMA-4, 1-5/8 by 7/8 inches by length indicated with anchor straps or studs not less than 3 inches long at not more than 8 inches o.c. Provide with temporary filler and tee-head bolts, complete with washers and nuts, all zinc-plated to comply with ASTM B633, Class Fe/Zn 5, as needed for fastening to inserts.

2.4 MISCELLANEOUS MATERIALS

A. Shop Primers: Provide primers that comply with Section 09 9123 "Interior Painting."

B. Galvanizing Repair Paint: High-zinc-dust-content paint complying with SSPC-Paint 20 and compatible with paints specified to be used over it.

C. Bituminous Paint: Cold-applied asphalt emulsion complying with ASTM D1187/D1187M.

D. 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.

E. Concrete: Comply with requirements in Section 03 3000 "Cast-in-Place Concrete" for normal-weight, air-entrained concrete with a minimum 28-day compressive strength of 3000 psi.

2.5 FABRICATION, GENERAL

A. Shop Assembly: Preassemble items in the shop to greatest extent possible. Disassemble units only as necessary for shipping and handling limitations. Use connections that maintain structural value of joined pieces. Clearly mark units for reassembly and coordinated installation.

B. Cut, drill, and punch metals cleanly and accurately. Remove burrs and ease edges to a radius of approximately 1/32 inch unless otherwise indicated. Remove sharp or rough areas on exposed surfaces.

C. Form bent-metal corners to smallest radius possible without causing grain separation or otherwise impairing work.

D. Form exposed work with accurate angles and surfaces and straight edges.

E. Weld corners and seams continuously to comply with the following:

1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
2. Obtain fusion without undercut or overlap.
3. Remove welding flux immediately.
4. At exposed connections, finish exposed welds and surfaces smooth and blended so no roughness shows after finishing 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, 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. 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.

C. Galvanize miscellaneous framing and supports.

2.7 METAL LADDERS

A. General:

1. Comply with ANSI A14.3.

B. Steel Ladders:

1. Space siderails 18 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-square, 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 aluminum-oxide grout.
6. Provide nonslip surfaces on top of each rung by coating with abrasive material metallically bonded to rung.

    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) Harsco Industrial IKG, a division of Harsco Corporation.
        2) Ross Technology Corporation.
        3) W.S. Molnar Company.

7. Source Limitations: Obtain nonslip surfaces from single source from single manufacturer.
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 ladders, including brackets.

2.8 METAL BOLLARDS

A. Fabricate metal bollards from Schedule 80 steel pipe.

B. Fabricate sleeves for bollard anchorage from steel or stainless steel pipe or tubing with 1/4-inch-thick, steel or stainless steel plate welded to bottom of sleeve. Make sleeves not less than 8 inches deep and 3/4 inch larger than OD of bollard.

C. Prime steel bollards with zinc-rich primer.

2.9 LOOSE BEARING AND LEVELING PLATES

A. 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.

2.10 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.

2.11 STEEL AND IRON FINISHES

A. Shop prime steel prior to its delivery to the job site.

B. 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.

C. 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.

D. Preparation for Shop Priming: Prepare surfaces to comply with SSPC-SP 6/NACE No. 3, "Commercial Blast Cleaning."

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.

PART 3 - EXECUTION

3.1 INSTALLATION, GENERAL

A. Cutting, Fitting, and Placement: Perform cutting, drilling, and fitting required for installing metal fabrications. Set metal fabrications accurately in location, alignment, and elevation; with edges and surfaces level, plumb, true, and free of rack; and measured from established lines and levels.

B. Fit exposed connections accurately together to form hairline joints. Weld connections that are not to be left as exposed joints but cannot be shop welded because of shipping size limitations. Do not weld, cut, or abrade surfaces of exterior units that have been hot-dip galvanized after fabrication and are for bolted or screwed field connections.

C. Field Welding: Comply with the following requirements:

1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.

2. Obtain fusion without undercut or overlap.
3. Remove welding flux immediately.
4. At exposed connections, finish exposed welds and surfaces smooth and blended so no roughness shows after finishing and contour of welded surface matches that of adjacent surface.

D. Fastening to In-Place Construction: Provide anchorage devices and fasteners where metal fabrications are required to be fastened to in-place construction. Provide threaded fasteners for use with concrete and masonry inserts, toggle bolts, through bolts, lag screws, wood screws, and other connectors.

E. Provide temporary bracing or anchors in formwork for items that are to be built into concrete, masonry, or similar construction.

3.2 INSTALLATION OF METAL BOLLARDS

A. Fill metal-capped bollards solidly with concrete and allow concrete to cure seven days before installing.

B. Anchor bollards in concrete in formed or core-drilled holes not less than 42 inches deep and 3/4 inch larger than OD of bollard. Fill annular space around bollard solidly with shrinkage-resistant grout; mixed and placed to comply with grout manufacturer's written instructions. Slope grout up approximately 1/8 inch toward bollard.

C. Fill bollards solidly with concrete, mounding top surface to shed water.

3.3 REPAIRS

A. Touchup Painting:

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 09 9123 "Interior Painting."

B. Galvanized Surfaces: Clean field welds, bolted connections, and abraded areas and repair galvanizing to comply with ASTM A780/A780M.

END OF SECTION 05 5000

SECTION 05 5213 - PIPE AND TUBE RAILINGS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Stainless-steel pipe and tube exterior railings.

1.2 COORDINATION

A. 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. Deliver such items to Project site in time for installation.

1.3 ACTION SUBMITTALS

A. Product Data: For the following:

1. Grout and anchoring cement products.

B. Shop Drawings: Include plans, elevations, sections, details, and attachments to other work.

C. Samples: 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 finishing members at intersections.

1.4 INFORMATIONAL SUBMITTALS

A. Qualification Data: For testing agency.

B. Welding certificates.

C. Mill Certificates: Signed by manufacturers of stainless-steel products certifying that products furnished comply with requirements.

D. Product Test Reports: For pipe and tube railings, for tests performed by a qualified testing agency, according to ASTM E894 and ASTM E935.

E. Evaluation Reports: For post-installed anchors, from ICC-ES.

1.5 QUALITY ASSURANCE

A. Welding Qualifications: Qualify procedures and personnel according to the following:

1. AWS D1.6/D1.6M, "Structural Welding Code - Stainless Steel."

B. Mockups: Build mockups to verify selections made under Sample submittals, to demonstrate aesthetic effects, and to set quality standards for fabrication and installation.

1. For railings, 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.
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. Protect mechanical finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.

1.7 FIELD CONDITIONS

A. Field Measurements: Verify actual locations of construction contiguous with railing fabrications by field measurements before fabrication.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Stainless-Steel Pipe and Tube Railings:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Blum, Julius & Co., Inc.
b. CraneVeyor Corp.
c. R & B Wagner, Inc.
d. Stainless Fabricators, Inc.
e. Trex Commercial Products, Inc.
f. Tubular Specialties Manufacturing, Inc.

g. VIVA Railings, LLC.

B. Source Limitations: Obtain each type of railing from single source from single manufacturer.

2.2 PERFORMANCE REQUIREMENTS

A. Structural Performance: Railings, including attachment to building construction, shall withstand the effects of gravity loads and the following loads and stresses within limits and under conditions indicated:

1. Handrails and Top Rails of Guards:

a. Uniform load of 50 lbf/ ft. 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.

B. Thermal Movements: Allow for thermal movements from ambient and surface temperature changes.

1. Temperature Change: 120 deg F, ambient; 180 deg F, material surfaces.

2.3 METALS, GENERAL

A. Metal Surfaces, General: Provide materials with smooth surfaces, without seam marks, roller marks, rolled trade names, stains, discolorations, or blemishes.

B. 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.

2.4 STAINLESS STEEL

A. Tubing: ASTM A554, Grade MT 304.

B. Pipe: ASTM A312/A312M, Grade TP 304.

C. Castings: ASTM A743/A743M, Grade CF 8 or CF 20.

D. Plate and Sheet: ASTM A240/A240M or ASTM A666, Type 304.

2.5 FASTENERS

A. General: Provide the following:

1. Stainless-Steel Railings: Type 304 stainless-steel fasteners.

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 indicated and capable of withstanding design loads.

2.6 MISCELLANEOUS MATERIALS

A. Welding Rods and Bare Electrodes: Select according to AWS specifications for metal alloy welded.

1. For 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.

B. 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.

2.7 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. Clearly mark units for reassembly and coordinated installation. Use connections that maintain structural value of joined pieces.

C. Cut, drill, and punch metals cleanly and accurately. Remove burrs and ease edges to a radius of approximately 1/32 inch unless otherwise indicated. Remove sharp or rough areas on exposed surfaces.

D. Form work true to line and level with accurate angles and surfaces.

E. Fabricate connections that are exposed to weather in a manner that excludes water. Provide weep holes where water may accumulate.

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 surfaces smooth and blended so no roughness shows after finishing and welded surface matches contours of adjoining surfaces.

I. Form Changes in Direction as Follows:

1. As detailed.

J. For changes in direction made by bending, use jigs to produce uniform curvature for each repetitive configuration required. Maintain cross section of member throughout entire bend without buckling, twisting, cracking, or otherwise deforming exposed surfaces of components.

K. Close exposed ends of railing members with prefabricated end fittings.

L. Flanges, Fittings, and Anchors: Provide flanges, miscellaneous fittings, and anchors to interconnect railing members to other work unless otherwise indicated.

M. 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.

2.8 STAINLESS-STEEL FINISHES

A. Remove tool and die marks and stretch lines, or blend into finish.

B. Grind and polish surfaces to produce uniform, directionally textured, polished finish indicated, free of cross scratches. Run grain with long dimension of each piece.

C. Stainless Steel Tubing Finishes:

1. 180-Grit Polished Finish: Uniform, directionally textured finish.

D. Stainless Steel Sheet and Plate Finishes:

1. Directional Satin Finish: ASTM A489/A480, No. 4.

E. When polishing is completed, passivate and rinse surfaces. Remove embedded foreign matter and leave surfaces chemically clean.

PART 3 - EXECUTION

3.1 INSTALLATION, GENERAL

A. Fit exposed connections together to form tight, hairline joints.

B. Perform cutting, drilling, and fitting required for installing railings. Set railings accurately in location, alignment, and elevation; measured from established lines and levels and free of rack.

1. Do not weld, cut, or abrade surfaces of railing components that are coated or finished after fabrication and that are intended for field connection by mechanical or other means without further cutting or fitting.
2. Set posts plumb within a tolerance of 1/16 inch in 3 feet.
3. Align rails so variations from level for horizontal members and variations from parallel with rake of steps and ramps for sloping members do not exceed 1/4 inch in 12 feet.

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.

3.2 RAILING CONNECTIONS

A. Welded Connections: Use fully welded joints for permanently connecting railing components. Comply with requirements for welded connections in "Fabrication" Article whether welding is performed in the shop or in the field.

3.3 ANCHORING POSTS

A. Use metal sleeves preset and anchored into concrete for installing stainless steel posts. After posts are inserted into sleeves, fill annular space between post and sleeve with nonshrink, nonmetallic grout, mixed and placed to comply with anchoring material manufacturer's written instructions.

B. Leave anchorage joint exposed with anchoring material flush with adjacent surface.

3.4 ADJUSTING AND CLEANING

A. Clean stainless steel by washing thoroughly with clean water and soap and rinsing with clean water.

3.5 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.

END OF SECTION 05 5213

SECTION 06 1000 - 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 06 1600 "Sheathing" for sheathing, subflooring, and underlayment.
2. Section 06 1753 "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. Lumber grading agencies, and abbreviations used to reference them, include the following:

1. NLGA: National Lumber Grades Authority.
2. SPIB: The Southern Pine Inspection Bureau.
3. WCLIB: West Coast Lumber Inspection Bureau.
4. WWPA: Western Wood Products Association.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of process and factory-fabricated product. Indicate component materials and dimensions and include construction and application details.

1. Include data for wood-preservative treatment from chemical treatment manufacturer and certification by treating plant that treated materials comply with requirements. Indicate type of preservative used and net amount of preservative retained.

2. Include data for fire-retardant treatment from chemical treatment manufacturer and certification by treating plant that treated materials comply with requirements. Include physical properties of treated materials based on testing by a qualified independent testing agency.
3. For 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:

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 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.

1.6 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 GENERAL

A. Suppliers:

1. Builders First Choice, West Jordan, UT. www.BLDR.com. Contact Dan Egelund.

a. Office: (801) 224-0541.
b. Mobile: (801) 376-2385.
c. E-Mail: Dan.Egelund@bldr.com

2. J. M. Thomas Forest Products, Ogden, UT. www.thomasforest.com. Contact Tom Karren:

    a. Office: (800) 962-8780.
    b. FAX: 801-782-9652.
    c. E-Mail: tom@thomasforest.com.

3. Shelter Products, Inc., Portland, OR www.shelter-products.com. Contact Grant Buchanan or Andy Beltz:

    a. Office: (800) 662-3612.
    b. Cell: NA.
    c. FAX: (503) 238-2663.
    d. E-Mail: gbuchanan@shelter-products.com.
    e. E-mail: abeltz@shelter-products.com.

2.2 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. 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.
3. Dress lumber, S4S, unless otherwise indicated.

B. Maximum Moisture Content:

1. Boards: 15 percent.
2. Dimension Lumber: 15 percent unless otherwise indicated.

2.3 WOOD-PRESERVATIVE-TREATED LUMBER

A. Preservative Treatment by Pressure Process: AWPA U1, Use categories as follows:

1. UC2: Interior construction not in contact with ground but may be subject to moisture. Include the following items:

    a. Wood sills and similar concealed members in contact with masonry or concrete.
    b. Wood framing and furring attached directly to the interior of below-grade exterior concrete walls.
    c. Wood floor plates that are installed over concrete slabs-on-grade.

2. Preservative Chemicals: Acceptable to authorities having jurisdiction and containing no arsenic or chromium. Do not use inorganic boron (SBX) for sill plates.

3. 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.

D. Application: Treat items indicated on Drawings, and the following:

1. Wood cants, nailers, curbs, equipment support bases, stripping, and similar members in connection with roofing, flashing, vapor barriers, and waterproofing.
2. Wood framing and furring attached directly to the interior of below-grade exterior masonry or concrete walls.
3. Wood floor plates that are installed over concrete slabs-on-grade.

2.4 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 feet beyond the centerline of the burners at any time during the test.

1. Treatment is not to promote corrosion of metal fasteners.
2. 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.
3. Design Value Adjustment Factors: Treated lumber is to be tested according to ASTM D5664 and design value adjustment factors are to be calculated according to ASTM D6841. For enclosed roof framing, 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 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.

E. Application: Treat items indicated on Drawings, and the following:

1. Concealed blocking.

2. Wood cants, nailers, curbs, equipment support bases, blocking, and similar members in connection with roofing.
3. Plywood backing panels.

2.5 DIMENSION LUMBER FRAMING

A. Non-Load-Bearing Interior Partitions by Grade: Construction or No. 2 grade.

1. Application: Interior partitions.
2. Species:

    a. Northern species; NLGA.
    b. Western woods; WCLIB or WWPA.

B. Load-Bearing Partitions by Grade: LSL studs as specified in Section 06 1715 "Engineered Structural Wood".

C. Ceiling Joists: Construction or No. 2 grade.

1. Species:

    a. Douglas fir-larch; WCLIB or WWPA.

D. Exposed Framing: Hand-select material 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. Species and Grade:

    a. As indicated above for load-bearing construction of same type.

2.6 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.

B. Dimension Lumber Items: Construction or No. 2 grade lumber of any of the following species:

1. Western woods; WCLIB or WWPA.
2. Northern species; NLGA.

C. Concealed Boards: 15 percent maximum moisture content and any of the following species and grades:

1. Northern species; No. 2 Common grade; NLGA.
2. Western woods; Construction or No. 2 Common grade; WCLIB or WWPA.

D. Roofing Nailers: Structural- or No. 2-grade lumber or better; kiln-dried Douglas fir, southern pine, or wood having similar decay-resistant properties.

E. 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.

2.7 PLYWOOD BACKING PANELS

A. Equipment Backing Panels: Plywood, DOC PS 1, Exterior, A-C, fire-retardant treated, in thickness indicated or, if not indicated, not less than 1/2-inch nominal thickness.

2.8 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 with hot-dip zinc coating complying with ASTM A153/A153M or ASTM F2329.

B. Nails, Brads, and Staples: ASTM F1667.

C. Post-Installed Anchors: Fastener systems with an evaluation report acceptable to authorities having jurisdiction, based on ICC-ES AC01, ICC-ES AC58, ICC-ES AC193, or ICC-ES AC308 as appropriate for the substrate.

2.9 METAL FRAMING ANCHORS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. MiTek Industries, Inc.
2. Simpson Strong-Tie Co., Inc.
3. KC Metals Inc.
4. United Steel Products Co (USP)
5. Equals as approved by Architect through shop drawings submittal before installation.

B. 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.

C. Joist Ties: Flat straps, with holes for fasteners, for tying joists together over supports.

1. Width: 1-1/4 inches.
2. Thickness: 0.062 inch.
3. Length: 16 inches.

D. Hold-Downs: Unless noted otherwise, use brackets for bolting to wall studs and securing to foundation walls with anchor bolts or to other hold-downs with threaded rods and designed with first of two bolts placed seven bolt diameters from reinforced base.

E. Wall Bracing:

1. T-shaped bracing made for letting into studs in saw kerf, 1-1/8 inches wide by 9/16 inch deep by 0.034 inch thick with hemmed edges.
2. Angle bracing made for letting into studs in saw kerf, 15/16 by 15/16 by 0.040 inch thick with hemmed edges.

F. Drag Strut Connectors: Unless noted otherwise, use 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.

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. Heavy-Galvanized-Steel Sheet: Hot-dip, zinc-coated steel sheet complying with 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.

2.10 MISCELLANEOUS MATERIALS

A. Sill-Sealer Gaskets:

1. Glass-fiber-resilient insulation, fabricated in strip form, for use as a sill sealer; 1-inch nominal thickness, compressible to 1/32 inch; selected from manufacturer's standard widths to suit width of sill members indicated.

PART 3 - EXECUTION

3.1 INSTALLATION

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. Install plywood 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. Install metal framing anchors to comply with manufacturer's written instructions. Install fasteners through each fastener hole.

E. Install sill sealer gasket to form continuous seal between sill plates and foundation walls.

F. Do not splice structural members between supports unless otherwise indicated.

G. 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.

H. 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.

I. Comply with AWPA M4 for applying field treatment to cut surfaces of preservative-treated lumber.

1. Use inorganic boron for items that are continuously protected from liquid water.

J. 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.

K. 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.

L. 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 WOOD BLOCKING AND NAILERS

A. Install where indicated 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. Attach wood blocking to substrates to support applied loading. Recess bolts and nuts flush with surfaces unless otherwise indicated.

C. Attach wood roofing nailers securely to substrate to resist the designed outward and upward wind loads indicated on Drawings and in accordance with ANSI/SPRI ED-1, Tables A6 and A7.

3.3 INSTALLATION OF WALL AND PARTITION FRAMING

A. General: Provide single bottom plate and double top plates using members of 2-inch nominal 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 interior partitions and walls, provide 2-by-6-inch nominal- size wood studs spaced 16 inches o.c. unless otherwise indicated.
2. 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 feet 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.

D. Provide diagonal bracing in walls, at locations indicated, 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.

3.4 INSTALLATION OF CEILING JOIST AND RAFTER FRAMING

A. Ceiling Joist: Install with crown edge up.

B. 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.

END OF SECTION 06 1000

SECTION 06 1600 - SHEATHING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Wall sheathing.
2. Parapet sheathing.
3. Roof sheathing.
4. Sheathing joint and penetration treatment.

B. Related Requirements:

1. Section 06 1000 "Rough Carpentry" for plywood backing panels.

1.2 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1.3 INFORMATIONAL SUBMITTALS

A. Qualification Data: For Installer.

B. Evaluation Reports: For the following, from ICC-ES:

1.4 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 WOOD PANEL PRODUCTS

A. Thickness: As needed to comply with requirements specified, but not less than thickness indicated.

B. Factory mark panels to indicate compliance with applicable standard.

2.2 WALL SHEATHING

A. Plywood Sheathing: DOC PS 1, Exposure 1, Structural I sheathing.

1. Span Rating: Not less than span rating indicated on Structural Drawings.
2. Nominal Thickness: Not less than 5/8 inch, but not less than required to comply with roofing manufacturer's requirements.

2.3 PARAPET SHEATHING

A. Plywood Sheathing: DOC PS 1, Exposure 1, Structural I sheathing.

1. Span Rating: Not less than span rating indicated on Structural Drawings.
2. Nominal Thickness: Not less than 5/8 inch, but not less than required to comply with roofing manufacturer's requirements

2.4 ROOF SHEATHING

A. Plywood Sheathing: DOC PS 1, Exposure 1 sheathing.

1. Span Rating: Not less than span rating indicated on Structural Drawings.
2. Nominal Thickness: Not less than 15/32 inch, unless indicated otherwise.

2.5 FASTENERS

A. General: Provide fasteners of size and type indicated that comply with requirements specified in this article for material and manufacture.

1. For roof, parapet and wall sheathing, provide fasteners with hot-dip zinc coating complying with ASTM A153/A153M.

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.

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 2304.9.1, "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 PANEL

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. 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. Space panels 1/8 inch apart at edges and ends.

END OF SECTION 06 1600

SECTION 06 1715 - ENGINEERED STRUCTURAL WOOD

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Structural composite lumber.
2. Prefabricated wood I-joists.
3. Engineered rim boards.

B. Related Requirements:

1. Section 06 1000 "Rough Carpentry" for dimension lumber items associated with engineered structural wood.

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. Include data on adhesives, fabrication, and protection.
2. For connectors, include installation instructions.

B. Shop Drawings:

1. Submit wood floor and roof-framing layouts including dimension lumber, engineered wood products, and plated wood trusses. Include computer-generated design calculations for representative joist and beam types.
2. Identify location and magnitude of design loads on layouts and in member calculations.
3. Include alternate span loading design results in design calculations.
4. Identify metal connectors (joist, beam, post cap, anchors, etc.) by manufacturer and model number. Include a list of accessories required for installation at each connector (blocking, squash blocks, stiffeners, fasteners, etc.). Include allowable design loads for selected metal connectors in design calculation analysis.
5. Identify manufacturer's recommended installation details in layouts.
6. Provide documentation that allowable design stresses comply with allowable design properties of each product indicated.
7. Include large-scale details of connections.
8. Fastener Patterns: Full-size templates for fasteners in exposed framing.

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.

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. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

    a. Weyerhaeuser Company.
    b. Equal, approved by Architect and Structural Engineer.

2. Allowable Stresses:

    a. Extreme Fiber Stress in Bending, Edgewise (Fb): 2600 psi for 12-inch nominal-depth members.
    b. Modulus of Elasticity, Edgewise (E): 2,000,000 psi.

2.4 PREFABRICATED WOOD I-JOISTS

A. Prefabricated Units: I-shaped in cross section, made with solid or structural composite lumber flanges and wood-based structural webs, let into and bonded to flanges. Comply with material requirements of, and with structural capacities established and monitored in accordance with, ASTM D5055.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

    a. Weyerhaeuser Company.
    b. Boise Cascade Company.
    c. Jager Industries Inc
    d. Roseburg Forest Products
    e. Web Joist
    f. Equal, approved by Architect.

2. Flange Material: Laminated-veneer lumber.
3. Web Material: OSB, Exposure 1.

    a. Field-applied coatings, panels, and membranes are unacceptable.

4. Structural Properties: Depths and design values not less than those indicated.
5. Identification Marks:

a. Comply with APA PRI-400. Factory mark I-joists with APA-EWS trademark indicating nominal joist depth, joist series, referenced standard (APA PRI-400) or APA Product Report number, and manufacturing plant number.
b. Factory mark I-joists with manufacturer's name, joist 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 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: LVL.
3. Thickness: As indicated.
4. Identification Marks: Comply with APA PRR-401, rim board grade.

a. Factory mark rim board with APA-EWS trademark indicating thickness, grade, and 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.

2.6 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 AC0,1 ICC-ES AC58, ICC-ES AC193, 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. As indicated in the construction documents, or at a minimum, as indicated below:

1. Thickness: 0.040 inch
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. As indicated in the construction document, or at a minimum, as indicated below:

1. Strap Width: 1-1/2 inches.
2. Thickness: 0.050 inch

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.

F. Joist Ties: Flat straps, with holes for fasteners, for tying joists together over supports. As indicated in the construction documents, or at a minimum, as indicated below:

1. Width: 1-1/4 inches.
2. Thickness: 0.062 inch.
3. Length: 16 inches, unless indicated otherwise.

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.

2.8 MISCELLANEOUS MATERIALS

A. Sill-Sealer Gaskets:

1. Glass-fiber-resilient insulation, fabricated in strip form, for use as sill sealer; 1-inch nominal thickness, compressible to 1/32 inch; 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. 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.

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 PREFABRICATED WOOD I-JOISTS

A. Install to comply with ESR report, manufacturer's written instructions, and applicable code.

1. Install in dry, covered conditions where in-service moisture content of wood does not exceed 16 percent.
2. Install metal framing connections in accordance with AWC's "National Design Specification (NDS) for Wood Construction." Install fasteners through each fastener hole.
3. Install joists with top and bottom flanges within 1/2 inch of true vertical alignment, and support ends of each member with not less than 1-3/4 inches for end bearing and 3-1/2 inches for intermediate bearings.
4. Provide temporary bracing to maintain lines and levels until permanent supporting members are in place.
5. Provide lateral restraint at supports to prevent rotation, and along the compression flange of each joist.
6. Completely install and properly nail hangers, rim joists, rim boards, blocking panels, and x-bracing as each joist is set.

B. Cantilevered portions of joists must not exceed a maximum length equal to one-third the adjacent span, and support only uniform loads, unless designed by a design professional and approved by authorities having jurisdiction.

1. Temporarily secure ends of cantilevers with strut lines on both top and bottom flanges. Remove only as required to install permanent sheathing.

C. Cutting: Do not splice structural members between supports unless otherwise indicated.

1. Do not cut, drill, or notch I-joist top and bottom flanges except for cutting to length.

3.5 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.

END OF SECTION 06 1715

SECTION 06 1753 - SHOP-FABRICATED WOOD TRUSSES

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Wood roof trusses.
2. Girder trusses.

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 fire-retardant-treated lumber, metal-plate connectors, metal truss accessories, and fasteners.

1. 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.
2. 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 according to ASTM D5664.
3. 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 Submittal: 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. Qualification Data: For metal connector-plate manufacturer, professional engineer, and fabricator.

B. Material Certificates: For dimension lumber specified to comply with minimum specific gravity. Indicate species and grade selected for each use and specific gravity.

C. Product Certificates: For metal-plate-connected wood trusses, signed by officer of truss-fabricating firm.

D. Evaluation Reports: For the following, from ICC-ES:

1. Fire-retardant-treated wood.
2. Metal-plate connectors.
3. 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.

C. 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.

D. Where conflicting information is found in the Construction Documents related to products, details or dimensional discrepancies, comply with the most stringent requirements regardless of cost.

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 01 4000 "Quality Requirements," to design metal-plate-connected wood trusses.

B. Structural Performance: Metal-plate-connected wood trusses shall 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 in structural drawings.

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."

2.2 DIMENSION LUMBER

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 15 percent maximum moisture content at time of dressing.

B. Minimum Specific Gravity for Top Chords: 0.50.

C. Permanent Bracing: Provide wood bracing that complies with requirements for miscellaneous lumber in Section 06 1000 "Rough Carpentry."

2.3 FIRE-RETARDANT-TREATED WOOD

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 according to 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.

1. Use treatment that does not promote corrosion of metal fasteners.
2. Exterior Type: Treated materials shall comply with requirements specified above for fire-retardant-treated lumber and plywood by pressure process after being subjected to accelerated weathering according to ASTM D2898. Use for exterior locations and where indicated.
3. Interior Type A: Treated materials shall have a moisture content of 28 percent or less when tested according to ASTM D3201 at 92 percent relative humidity. Use for interior locations where exterior type is not indicated.
4. Design Value Adjustment Factors: Treated lumber shall be tested according to ASTM D5664, and design value adjustment factors shall be calculated according to ASTM D6841. For enclosed roof framing, 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 15 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 or omit marking and provide certificates of treatment compliance issued by inspection agency.

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 all trusses unless otherwise indicated.

2.4 METAL CONNECTOR PLATES

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Alpine Engineered Products, Inc.; a division of ITW Building Components Group, Inc.
2. CompuTrus, Inc.
3. Eagle Metal Products.
4. Jager Building Systems, Inc.
5. MiTek Industries, Inc.
6. Robbins Engineering, Inc.
7. Truswal Systems Corporation.
8. Simpson AS Truss Connector Plates

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.

2.5 FASTENERS

A. Provide fasteners of size and type indicated that comply with requirements specified in this article for material and manufacture.

1. Provide fasteners for use with metal framing anchors that comply with written recommendations of metal framing manufacturer.
2. Where trusses are made from pressure-preservative treated wood, provide fasteners with hot-dip zinc coating complying with ASTM A153/A153M.

B. Nails, Brads, and Staples: ASTM F1667.

2.6 METAL FRAMING ANCHORS AND ACCESSORIES

A. Basis-of-Design Manufacturer: Simpson Strong-Tie Co., Inc.

1. Subject to compliance with requirements, provide metal framing anchors from Basis-of-Design Manufacturer or a comparable product approved by architect prior to bid, by another manufacturer.

B. Allowable design loads, as published by manufacturer, shall comply with or exceed those indicated by engineering analysis or shown in the structural drawings. Manufacturer's published values shall be determined from empirical data or by rational engineering analysis and demonstrated by comprehensive testing performed by a qualified independent testing agency. Framing anchors shall 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. Truss Tie-Downs: as indicated in the drawings. Tie fastens to truss, top plates, and stud below.

E. 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.

F. 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 unless noted otherwise.

G. 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 unless noted otherwise.

H. Drag Strut Connectors: as indicated in the drawings.

2.7 MISCELLANEOUS MATERIALS

A. Galvanizing Repair Paint: SSPC-Paint 20, with dry film containing a minimum of 92 percent zinc dust by weight.

2.8 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.

2.9 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 06 1000 "Rough Carpentry."
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 according to 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 1753

SECTION 06 1800 - GLUED-LAMINATED CONSTRUCTION

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Framing using structural glued-laminated timber.

B. Related Requirements:

1. Section 06 1000 "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 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 Submittal: 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 AITC 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 and timber connectors, from ICC-ES.

1.5 QUALITY ASSURANCE

A. 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.

B. Designer Qualifications: Design structural members under direct supervision of a Professional Structural Engineer experienced in design of this work and licensed in the State in which the Project is located.

C. Manufacturer/Fabricator Qualifications: Company specializing in manufacture of glue laminated structural units with five years of documented experience, and certified by AITC in accordance with AITC A190.1.

D. Erector Qualifications: Company specializing in erection of products of the type specified with five years documented experience, and approved by manufacturer.

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.

PART 2 - PRODUCTS

2.1 STRUCTURAL GLUED-LAMINATED TIMBER

A. General: Provide structural glued-laminated timber that complies with AITC A190.1 and AITC 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 with wet-use adhesive complying with AITC A190.1.

B. Species and Grades for Structural Glued-Laminated Timber: Douglas fir-larch in grades specified in structural notes.

C. Species and Grades for Beams and Purlins:

1. Species and Combination Symbol: Douglas fir-larch, 24F-V4.

a. For cantilevered and continuous beams, use Douglas fir-larch, 24F-V8.

2. Lay-up: Balanced.

2.2 PRESERVATIVE TREATMENT

A. Preservative Treatment: Where preservative-treated structural glued-laminated timber is indicated, comply with AWPA U1, Use Category 3B.

1. Use preservative solution without substances that might interfere with application of indicated finishes.
2. Do not incise structural glued-laminated timber or wood used to produce structural glued-laminated timber.

B. After dressing members, apply a copper naphthenate field-treatment preservative to comply with AWPA M4 to surfaces cut to a depth of more than 1/16 inch.

2.3 TIMBER CONNECTORS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Cleveland Steel Specialty Co.
2. Simpson Strong-Tie Co., Inc.
3. USP Structural Connectors.

B. Fabricate beam seats from stainless steel with 3/8-inch bearing plates, 3/4-inch-diameter-by-12-inch-long deformed bar anchors, and 0.239-inch side plates unless noted otherwise.

C. Fabricate beam hangers from stainless steel with 0.179-inch stirrups and 0.239-inch top plates unless noted otherwise.

D. Fabricate strap ties from stainless steel, 3 inches wide by 0.239 inch thick unless noted otherwise.

E. Fabricate tie rods from round steel bars with upset threads connected with forged-steel turnbuckles complying with ASTM A668/A668M.

F. Provide bolts, 3/4 inch unless otherwise indicated, complying with ASTM A307, Grade A; nuts complying with ASTM A563; and, where indicated, flat washers.

G. Provide shear plates, 4 inches in diameter, complying with ASTM D5933.

H. Materials: Unless otherwise indicated, fabricate from the following materials:

1. Structural-steel shapes, plates, and flat bars complying with ASTM A572 GR 50/A572M.
2. Round steel bars complying with ASTM A575, Grade M 1020.

2.4 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.

2.5 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.

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.

2.6 FACTORY FINISHING

A. Clear Finish: Manufacturer's standard, resistant to mildew and fungus.

1. Film-forming two-coat, varnish.

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 place.

1. Handle and temporarily support glued-laminated timber to prevent surface damage, compression, and other effects that might interfere with indicated finish.

B. Cutting: Avoid extra cutting after fabrication. Where field fitting is unavoidable, comply with requirements for shop fabrication.

C. 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.

D. 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 1800

SECTION 06 4116 - PLASTIC-LAMINATE-CLAD ARCHITECTURAL CABINETS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Plastic-laminate-clad architectural cabinets.
2. Wood furring, blocking, shims, and hanging strips for installing plastic-laminate-clad architectural cabinets that are not concealed within other construction.

B. Related Requirements:

1. Section 06 1053 "Miscellaneous 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 12 3623 "Plastic-Laminate-Clad Countertops" for countertops.
3. Section 12 3662 "Solid Surface Countertops" for countertops.
4. Section 12 3663 "Quartz Agglomerate Countertops" for 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.

1.3 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product, including panel products, high-pressure decorative laminate shelves, and hardware and accessories.

B. Shop Drawings:

1. Include plans, elevations, sections, and attachment details.
2. Show locations and sizes of furring, blocking, and hanging strips, including concealed blocking and reinforcement specified in other Sections.

C. Samples for Verification: For the following:

1. Plastic laminates, 8 by 10 inches, for each type, color, pattern, and surface finish, with one sample applied to core material and specified edge material applied to one edge.
2. Thermoset decorative panels, 8 by 10 inches, for each color, pattern, and surface finish, with edge banding on one edge.
3. Exposed Cabinet Hardware and Accessories: One full-size unit for each type and finish.

1.5 INFORMATIONAL SUBMITTALS

A. Qualification Data: For manufacturer and Installer.

B. Product Certificates: For the following:

1. Composite wood products.
2. Thermoset decorative panels.
3. High-pressure decorative laminate.
4. Adhesives.

C. Field quality-control reports.

1.6 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.

1. Manufacturer's Certification: Licensed participant in AWI's Quality Certification Program.

B. Installer Qualifications: Fabricator of products.

C. Mockups: 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 typical architectural cabinets as shown on Drawings.
2. 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. 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.

1.8 FIELD CONDITIONS

A. Environmental Limitations: 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 25 and 55 percent during the remainder of the construction period.

B. 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.

C. 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. Accessibility Requirements: Provide accessible lockers at 5 percent of any plastic-laminate-clad locker bank or area. For accessible lockers, comply with applicable provisions in the U.S. Architectural & Transportation Barriers Compliance Board's ADA-ABA Accessibility Guidelines and ICC A117.1.

2.2 ARCHITECTURAL CABINET MANUFACTURERS

A. Fabricators: Subject to compliance with requirements, provide products by one of the following mills, certified by AWI:

1. Firms certified by (AWI) Architectural Woodworking Institute:

a. Anvil Cabinet and Mill
b. Associated Fixture Manufacturing, Inc.
c. Boswell Wasatch Mill.
d. Clients Design, Inc.
e. Contempo Cabinet & Mill.
f. Fetzer’s Inc.
g. Granite Mill & Fixture Co.
h. Huetter Mill & Cabinet Inc.
i. JLR – Fondell.
j. Mapleleaf Cabinets, Inc.
k. Masterpiece Commercial Millwork.

l. Montgomery Custom Cabinets, Inc.
m. Oviatt Cabinet & Mill.
n. Riverwoods Mill, Inc.

2.3 PLASTIC-LAMINATE-CLAD ARCHITECTURAL CABINETS

A. Quality Standard: Unless otherwise indicated, comply with the Architectural Woodwork Standards for grades of cabinets indicated for construction, finishes, installation, and other requirements.

1. The Contract Documents contain requirements that are more stringent than the referenced quality standard. Comply with requirements of Contract Documents in addition to those of the referenced quality standard.

B. Grade: Custom.

C. Type of Construction: Frameless.

D. Door and Drawer-Front Style: Flush overlay.

E. High-Pressure Decorative Laminate: NEMA LD 3, grades as indicated or if not indicated, as required by quality standard.

1. Basis-of-Design Product: Items M3 (Formica; 5487-26) on Finish Legend in the Drawings.

a. Manufacturers: Subject to compliance with requirements, provide plastic laminate products indicated on the Finish Legend or an equal product, approved by architect prior to bid, by another manufacturer.

F. Laminate Cladding for Exposed Surfaces:

1. Horizontal Surfaces: Grade HGP.
2. Postformed Surfaces: Grade HGP.
3. Vertical Surfaces: Grade: HGS.
4. Edges: PVC edge banding, 3.0 mm thick, matching laminate in color, pattern, and finish.
5. Pattern Direction: Vertically for drawer fronts, doors, and fixed panels, unless directed otherwise.

G. Materials for Semiexposed Surfaces:

1. Thermoset Decorative Panels: Particleboard or MDF finished with thermally fused, melamine-impregnated decorative paper and complying with requirements of NEMA LD 3, Grade VGL, for Test Methods 3.3, 3.4, 3.6, 3.8, and 3.10.

a. Edges of Plastic-Laminate Shelves: PVC edge banding, 3.0 mm thick, matching laminate in color, pattern, and finish.
b. For semiexposed backs of panels with exposed plastic-laminate surfaces, provide surface of thermally fused melamine NEMA LD 3, Grade VGL.

2. Drawer Sides and Backs: Thermoset decorative panels with PVC or polyester edge banding.
3. Drawer Bottoms: Thermoset decorative panels.

H. Concealed Backs of Panels with Exposed Plastic-Laminate Surfaces: Thermally fused melamine NEMA LD 3, Grade VGL.

I. Drawer Construction: Fabricate with exposed fronts fastened to subfront with mounting screws from interior of body.

1. Join subfronts, backs, and sides with glued rabbeted joints supplemented by mechanical fasteners or glued dovetail joints.

J. 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 on Finish Legend.

2.4 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. Wood Moisture Content: 5 to 10 percent.

B. Composite Wood Products: Verify products are made using ultra-low-emitting formaldehyde resins, as defined in the California Air Resources Board's "Airborne Toxic Control Measure to Reduce Formaldehyde Emissions from Composite Wood Products," or are made with no added formaldehyde.

1. Medium-Density Fiberboard (MDF): ANSI A208.2, Grade 130.
2. Softwood Plywood: DOC PS 1, medium-density overlay.
3. Thermoset Decorative Panels: Particleboard or MDF finished with thermally fused, melamine-impregnated decorative paper and complying with requirements of NEMA LD 3, Grade VGL, for Test Methods 3.3, 3.4, 3.6, 3.8, and 3.10.
4. Do not use composite materials within 4 inches of finish floors in classrooms, restrooms, janitorial closets, or any area where water may be present.

2.5 CABINET HARDWARE AND ACCESSORIES

A. General: Provide cabinet hardware and accessory materials associated with architectural cabinets except for items specified in Section 08 7100 "Door Hardware."

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Accuride International.
b. Blum, Julius & Co., Inc.

c. CompX International, Inc.
d. Knape & Vogt Manufacturing Company.

A. Frameless Concealed Hinges (European Type): ANSI/BHMA A156.9, B01602, 170 degrees of opening, self-closing.

B. Pulls: TK Top Knobs; Cumberland Pull – 13606.

1. Color: As selected by Architect from Manufacturer's full range.
2. Size: As selected by Architect from Manufacturer's full range.

C. Catches: Push-in magnetic catches, ANSI/BHMA A156.9, B03131.

D. Adjustable Shelf Standards and Supports: ANSI/BHMA A156.9, B04071; with shelf rests, B04081.

E. Shelf Rests: BHMA A156.9, B04013; metal, two-pin type with shelf hold-down clip.

1. Basis of Design Standards: KV 85 Double-slot wall standard as provided by Knape and Vogt Manufacturing Company.
2. Basis of Design Brackets: KV 185 Double-flange wall bracket as provided by Knape and Vogt Manufacturing Company.
3. Color: Silver

F. Drawer Slides: ANSI/BHMA A156.9.

1. Grade 1: Side mounted.

a. Type: Full extension.
b. Material: Zinc-plated steel with nylon or stainless steel bearings.

2. Grade 1HD-100 and Grade 1HD-200: Side mounted; full-overtravel-extension type; zinc-plated-steel ball-bearing slides.
3. For drawers not more than 3 inches high and not more than 24 inches wide, provide Grade 1.
4. For drawers more than 3 inches high, but not more than 6 inches high and not more than 24 inches wide, provide Grade 1HD-100.
5. For drawers more than 6 inches high or more than 24 inches wide, provide Grade 1HD-200.

G. Door Locks: ANSI/BHMA A156.11, E07121.

H. Drawer Locks: ANSI/BHMA A156.11, E07041.

I. Door and Drawer Silencers: ANSI/BHMA A156.16, L03011.

J. Exposed Hardware Finishes: For exposed hardware, provide finish that complies with ANSI/BHMA A156.18 for ANSI/BHMA finish number indicated.

K. For concealed hardware, provide manufacturer's standard finish that complies with product class requirements in ANSI/BHMA A156.9.

2.6 MISCELLANEOUS MATERIALS

A. Furring, Blocking, Shims, and Hanging Strips: Fire-retardant-treated softwood lumber, kiln-dried to less than 15 percent moisture content.

B. Adhesive for Bonding Plastic Laminate: As selected by fabricator to comply with requirements.

1. Adhesive for Bonding Edges: Hot-melt adhesive or adhesive specified above for faces.

C. Adhesives: Do not use adhesives that contain urea formaldehyde.

D. Anchors: Select material, type, size, and finish required for each substrate for secure anchorage. Provide metal expansion sleeves or expansion bolts for post-installed anchors. Use nonferrous-metal or hot-dip galvanized anchors and inserts at inside face of exterior walls and at floors.

2.7 FABRICATION

A. Fabricate architectural cabinets to dimensions, profiles, and details indicated.

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. Notify Architect seven days in advance of the dates and times architectural cabinet fabrication will be complete.
2. Fabricate in a manner that allows minor vertical adjustments of base cabinets.

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.

PART 3 - EXECUTION

3.1 PREPARATION

A. Before installation, condition cabinets to humidity conditions in installation areas for not less than 72 hours.

3.2 INSTALLATION

A. Architectural Woodwork Standards Grade: Install cabinets to comply with quality standard grade of item to be installed.

B. Assemble cabinets and complete fabrication at Project site to extent that it was not completed in the shop.

C. Anchor cabinets to anchors or blocking built in or directly attached to substrates. Secure with wafer-head cabinet installation screws.

D. 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. Fasten wall cabinets through back, near top and bottom, and at ends not more than 16 inches o.c. with No. 10 wafer-head screws sized for not less than 1-1/2-inch penetration into wood framing, blocking, or hanging strips.

E. Apply specified joint sealants joints at all cabinets where sinks are installed.

3.3 ADJUSTING AND CLEANING

A. Repair damaged and defective cabinets, where possible, to eliminate functional and visual defects. Where not possible to repair, replace architectural cabinets. Adjust joinery for uniform appearance.

B. Clean, lubricate, and adjust hardware.

C. Clean cabinets on exposed and semiexposed surfaces.

END OF SECTION 06 4116

SECTION 07 1113 - BITUMINOUS DAMPPROOFING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Cold-applied, cut-back-asphalt dampproofing.

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 according 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 MANUFACTURERS

A. Source Limitations: Obtain primary dampproofing materials and primers from single source from single manufacturer. Provide drainage panels and auxiliary materials recommended in writing by manufacturer of primary materials.

B. Where conflicting information is found in the Construction Documents related to products, details or dimensional discrepancies, comply with the most stringent requirements regardless of cost.

2.2 PERFORMANCE REQUIREMENTS

A. VOC Content: Products shall comply with VOC content limits of authorities having jurisdiction unless otherwise indicated.

2.3 COLD-APPLIED, CUT-BACK-ASPHALT DAMPPROOFING

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. APOC, Inc; a division of Gardner Industries.
2. ChemMasters, Inc.
3. Henry Company.
4. W.R. Meadows, Inc.

B. Trowel Coats: ASTM D4586/D4586M, Type I, Class 1, fibered.

C. Brush and Spray Coats: ASTM D 4479/D 4479M, Type I, fibered.

2.4 AUXILIARY MATERIALS

A. Furnish auxiliary materials recommended in writing by dampproofing manufacturer for intended use and compatible with bituminous dampproofing.

B. Cut-Back-Asphalt Primer: ASTM D41/D41M.

C. Asphalt-Coated Glass Fabric: ASTM D1668/D1668M, Type I.

D. Patching Compound: Epoxy or latex-modified repair mortar of type recommended in writing by dampproofing manufacturer.

E. Protection Course: ASTM D6506, 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 waterproofing manufacturer for protection course type.

2.5 MOLDED-SHEET DRAINAGE PANELS

A. Nonwoven-Geotextile-Faced, Molded-Sheet Drainage Panel: Composite subsurface drainage panel acceptable to dampproofing manufacturer and consisting of a studded, nonbiodegradable, molded-plastic-sheet drainage core; with a nonwoven, needle-punched geotextile facing with an apparent opening size not exceeding No. 70 sieve laminated to one side of the core, with or without a polymeric film bonded to the other side; and with a vertical flow rate through the core of 9 to 21 gpm per ft.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. American Hydrotech, Inc.
b. Carlisle Coatings & Waterproofing Inc.
c. CETCO, a Minerals Technologies company.

d. GCP Applied Technologies Inc.
e. Polyguard Products, Inc.

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 according to manufacturer's written instructions. Provide clean, dust-free, and dry substrates for dampproofing application.

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; cover with asphalt-coated glass fabric.

3.3 APPLICATION, GENERAL

A. Comply with manufacturer's written instructions for dampproofing application, 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.

3.4 COLD-APPLIED, CUT-BACK-ASPHALT DAMPPROOFING

A. Concrete Foundations: Apply two brush or spray coats at not less than 1.25 gal./100 sq. ft. for first coat and 1 gal./100 sq. ft. for second coat or one trowel coat at not less than 4 gal./100 sq. ft.

3.5 PROTECTION COURSE INSTALLATION

A. Install protection course over completed-and-cured dampproofing. Comply with dampproofing-material and protection-course manufacturers' written instructions for attaching protection course.

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 DRAINAGE PANEL INSTALLATION

A. Molded- Sheet Drainage Panels: Install panels, with geotextile facing away from wall substrate, according to manufacturer's written instructions. Use adhesive or another method that does not penetrate dampproofing. Lap edges and ends of geotextile to maintain continuity. Protect installed molded-sheet drainage panels during subsequent construction.

1. Install protection course before installing drainage panels.

3.7 PROTECTION

A. Correct dampproofing that does not comply with requirements; repair substrates, and reapply dampproofing.

END OF SECTION 07 1113

SECTION 07 2100 - THERMAL INSULATION

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Extruded polystyrene foam-plastic board insulation.
2. Glass-fiber blanket insulation.

B. Related Requirements:

1. Section 07 5423 "Thermoplastic-Polyolefin (TPO) Roofing" for insulation specified as part of roofing construction.
2. Section 09 2900 "Gypsum Board" for sound attenuation blanket used as acoustic insulation.

1.2 ACTION SUBMITTALS

A. Product Data: For the following:

1. Extruded polystyrene foam-plastic board insulation.
2. Glass-fiber blanket insulation.

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 foam-plastic 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 time.
3. Quickly complete installation and concealment of foam-plastic board insulation in each area of construction.

PART 2 - PRODUCTS

2.1 EXTRUDED POLYSTYRENE FOAM-PLASTIC BOARD INSULATION

A. Extruded Polystyrene Board Insulation, Type VI: ASTM C578, Type VI, 40-psi minimum compressive strength.

1. Products: Subject to compliance with requirements, provide one of the following:

    a. Dow Chemical Company (The); STYROFOAM Brand HIGHLOAD 40 Insulation.
    b. Owens Corning; Foamular XPS.

2. Flame-Spread Index: Not more than 25 when tested in accordance with ASTM E84.
3. Smoke-Developed Index: Not more than 450 when tested in accordance with ASTM E84.
4. Labeling: Provide identification of mark indicating R-value of each piece of insulation 12 inches and wider in width.
5. Install at thin brick locations.

2.2 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, provide products by one of the following:

    a. CertainTeed Corporation.
    b. Johns Manville; a Berkshire Hathaway company.
    c. Knauf Insulation.
    d. Owens Corning.

2. Flame-Spread Index: Not more than 25 when tested in accordance with ASTM E84.
3. Smoke-Developed Index: Not more than 50 when tested in accordance with ASTM E84.
4. Labeling: Provide identification of mark indicating R-value of each piece of insulation 12 inches and wider in width.
5. Install at exterior stud walls unless indicated otherwise.

2.3 ACCESSORIES

A. Insulation for Miscellaneous Voids:

1. Spray Polyurethane Foam Insulation: ASTM C1029, Type II, closed cell, with maximum flame-spread and smoke-developed indexes of 75 and 450, respectively, per ASTM E84.

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 that interfere with insulation attachment.

3.2 INSTALLATION, GENERAL

A. Comply with insulation manufacturer's written instructions applicable to products and applications.

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 according to manufacturer's written instructions.

1. If not otherwise indicated, extend insulation a minimum of 36 inches below exterior grade line.

B. On horizontal surfaces, loosely lay insulation units according to manufacturer's written instructions. Stagger end joints and tightly abut insulation units.

1. If not otherwise indicated, extend insulation a minimum of 36 inches in from exterior walls.

3.4 INSTALLATION OF INSULATION IN FRAMED CONSTRUCTION

A. Blanket Insulation: Install in cavities formed by framing members according to 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. For wood-framed construction, install blankets according to 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.

B. Miscellaneous Voids: Install insulation in miscellaneous voids and cavity spaces where required to prevent gaps in insulation using the following materials:

1. Spray Polyurethane Insulation: Apply according to manufacturer's written instructions.

3.5 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 2100

SECTION 07 2119 - FOAMED-IN-PLACE INSULATION

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Closed-cell spray polyurethane foam.

B. Related Requirements:

1. Section 07 2100 "Thermal Insulation" for foam-plastic board insulation.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.

1.3 INFORMATIONAL SUBMITTALS

A. Qualification Data: For Installer.

B. Product Test Reports: For each product, for tests performed by a qualified testing agency.

1.4 QUALITY ASSURANCE

A. Installer Qualifications: An authorized representative who is trained and approved by manufacturer.

PART 2 - PRODUCTS

2.1 CLOSED-CELL SPRAY POLYURETHANE FOAM

A. Closed-Cell Spray Polyurethane Foam: ASTM C1029, 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.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Carlisle Spray Foam Insulation.
b. Gaco; Holcim Building Envelope.
c. Huntsman Building Solutions.
d. Thermoseal USA.

2. 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.

3. Fire Propagation Characteristics: Passes NFPA 285 testing as part of an approved assembly.

2.2 MISCELLANEOUS MATERIALS

A. Primer: Material recommended by insulation manufacturer where required for adhesion of insulation to substrates.

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

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. Cavity Walls: Install into cavities to fully fill void.

E. Miscellaneous Voids: Apply according to manufacturer's written instructions.

3.3 PROTECTION

A. Protect installed insulation from damage due to harmful weather exposures, physical abuse, and other causes.

END OF SECTION 07 2119

SECTION 07 2600 - VAPOR RETARDERS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Polyethylene vapor retarders.

B. Related Requirements:

1. Section 03 3000 "Cast-in-Place Concrete" for under-slab vapor retarders.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.

1.3 INFORMATIONAL SUBMITTALS

A. Product Test Reports: For each product, for tests performed by a qualified testing agency.

PART 2 - PRODUCTS

2.1 VAPOR RETARDERS

A. Provide one of the following:

1. Polyethylene Vapor Retarders:

a. Polyethylene Vapor Retarders: ASTM D4397, 10-mil- thick sheet, with maximum permeance rating of 0.1 perm.

2. Polyamide Film Vapor Retarders:

a. Polyamide Film Vapor Retarders: 2-mil- thick sheet, with maximum permeance rating of 0.1 perm.

1) Certainteed Corp.; MemBrain

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.

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.

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 PROTECTION

A. Protect vapor retarders from damage until concealed by permanent construction.

END OF SECTION 07 2600

SECTION 07 2715 - NONBITUMINOUS SELF-ADHERING SHEET AIR BARRIERS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes: Self-adhering air barrier.

1. Vapor-permeable nonbituminous sheet.

B. Related Requirements:

1. Section 06 1600 "Sheathing" for wall sheathings and wall sheathing joint-and-penetration treatments.

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: Self-adhering air barrier. Include manufacturer's written instructions for evaluating, preparing, and treating each substrate; technical data; and tested physical and performance properties of products.

1. Vapor-permeable nonbituminous sheet.

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 accessory materials with Project materials that connect to or that come in contact with air 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 source 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.

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.

2.3 NONBITUMINOUS SHEET AIR BARRIER

A. Vapor-Permeable Nonbituminous Sheet: Minimum 20-mil-thick, self-adhering sheet consisting of a breathable carrier film or fabric and an adhesive with release liner on adhesive side and formulated for application with primer that complies with VOC limits.

1. Basis-of-Design Product: VaproShield LLC; RevealShield SA Self-Adhered Water Resistive Barrier (WRB)/Air Barrier AB for Open Joint Cladding.

a. Provide basis of design products or, subject to compliance with requirements, provide an equivalent products by one of the following:

1) Dorken Systems Inc.
2) GCP Applied Technologies Inc.
3) Henry, a Carlisle Company (formerly Henry Company and Carlisle Coatings & Waterproofing Inc. brands).
4) W. R. Meadows, Inc.

2. Physical and Performance Properties:

a. Air Permeance: Maximum 0.004 cfm/sq. ft. of surface area at 1.57-lbf/sq. ft. pressure difference; ASTM E2178.
b. Vapor Permeance: Minimum 25 perms; ASTM E96/E96M, Desiccant Method, Procedure A.
c. Fire Propagation Characteristics: Passes NFPA 285 testing as part of an approved assembly.
d. UV Resistance: Can be exposed to sunlight for 365 days in accordance with manufacturer's written instructions.

2.4 ACCESSORY MATERIALS

A. Requirement: Provide primers, 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 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.

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 are visibly dry and free of moisture.

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. 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.

D. 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.

E. Bridge 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 NONBITUMINOUS SHEET AIR BARRIER

A. Install 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. Unless manufacturer recommends in writing against priming, apply primer to substrates at required rate and allow it to dry.

B. Prepare, treat, and seal inside and outside corners and vertical and horizontal surfaces at terminations and penetrations with termination mastic.

C. Apply primer to substrates at required rate and allow it to dry. Limit priming to areas that will be covered by air-barrier sheet on same day. Reprime areas exposed for more than 24 hours.

D. Apply and firmly adhere air-barrier sheets over area to receive air barrier. Accurately align sheets and maintain uniform 2-1/2-inch-minimum lap widths and end laps. Overlap and seal seams, and stagger end laps to ensure airtight installation.

1. Apply sheets in a shingled manner to shed water.
2. Roll sheets firmly to enhance adhesion to substrate.

E. Apply continuous air-barrier sheets over accessory strips bridging substrate cracks, construction, and contraction joints.

F. Seal top of through-wall flashings to air-barrier sheet with an additional 6-inch-wide, transition strip.

G. Seal exposed edges of sheet at seams, cuts, penetrations, and terminations not concealed by metal counterflashings or ending in reglets with termination mastic.

H. Install air-barrier sheet and accessory materials to form a seal with adjacent construction and to maintain a continuous air barrier.

1. Coordinate air-barrier installation 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.

I. Connect and seal exterior wall air-barrier sheet continuously to roofing-membrane air barrier, concrete below-grade structures, floor-to-floor construction, exterior glazing and window systems, storefront systems, exterior louvers, exterior door framing, and other construction used in exterior wall openings, using accessory materials.

J. At end of each working day, seal top edge of air-barrier material to substrate with termination mastic.

K. 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.

L. 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 contact over firm bearing to perimeter frames, with not less than 1 inch of full contact.

1. Transition Strip: Roll firmly to enhance adhesion.

M. Fill gaps in perimeter frame surfaces of windows, storefronts, doors, and miscellaneous penetrations of air-barrier material with foam sealant.

N. Repair punctures, voids, and deficient lapped seams in air barrier. Slit and flatten fishmouths and blisters. Patch with air-barrier sheet extending 6 inches beyond repaired areas in all directions.

O. Do not cover air barrier until it has been tested and inspected by testing agency.

P. Correct deficiencies in or remove air barrier that does not comply with requirements; repair substrates and reapply air-barrier components.

3.4 FIELD QUALITY CONTROL

A. ABAA Quality Assurance Program: Perform examinations, preparation, installation, testing, and inspections under ABAA's Quality Assurance Program.

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. Continuous structural support of air-barrier system has been provided.
3. Site conditions for application temperature and dryness of substrates have been maintained.
4. Maximum exposure time of materials to UV deterioration has not been exceeded.
5. Surfaces have been primed.
6. Laps in sheet materials have complied with the minimum requirements and have been shingled in the correct direction (or mastic applied on exposed edges), with no fishmouths.
7. Termination mastic has been applied on cut edges.
8. Air barrier has been firmly adhered to substrate.
9. Compatible materials have been used.
10. Transitions at changes in direction and structural support at gaps have been provided.
11. Connections between assemblies (air barrier and sealants) have complied with requirements for cleanliness, surface preparation and priming, structural support, integrity, and continuity of seal.
12. 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 ASTM E2357.
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.

3.5 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.

END OF SECTION 07 2715

SECTION 07 4114 - STANDING-SEAM METAL ROOF PANELS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Standing-seam metal roof panels.

1.2 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1. Meet with Owner, Architect, Owner's insurer if applicable, metal panel Installer, metal panel manufacturer's representative, structural-support Installer, and installers whose work interfaces with or affects metal panels, including installers of roof accessories and roof-mounted equipment.
2. Review and finalize construction schedule and verify availability of materials, Installer's personnel, equipment, and facilities needed to make progress and avoid delays.
3. Review methods and procedures related to metal panel installation, including manufacturer's written instructions.
4. Examine support conditions for compliance with requirements, including alignment between and attachment to structural members.
5. Review structural loading limitations of deck during and after roofing.
6. Review flashings, special details, drainage, penetrations, equipment curbs, and condition of other construction that affect metal panels.
7. Review governing regulations and requirements for insurance, certificates, and tests and inspections if applicable.
8. Review temporary protection requirements for metal panel systems during and after installation.
9. Review procedures for repair of metal panels damaged after installation.
10. Document proceedings, including corrective measures and actions required, and furnish copy of record to each participant.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for each type of panel and accessory.

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 the flashing, trim, and anchorage systems, at a scale of not less than 1-1/2 inches per 12 inches.

C. Samples for Initial Selection: For each type of metal panel indicated with factory-applied color finishes.

1. Include similar Samples of trim and accessories involving color selection.

D. Samples for Verification: For each type of exposed finish required, prepared on Samples of size indicated below.

1. Metal Panels: 12 inches long by actual panel width. Include clips, fasteners, closures, and other metal panel accessories.

1.4 INFORMATIONAL SUBMITTALS

A. Qualification Data: For Installer.

B. Product Test Reports: For each product, for tests performed by a qualified testing agency.

C. Field quality-control reports.

D. Sample Warranties: For special warranties.

1.5 CLOSEOUT SUBMITTALS

A. Maintenance Data: For metal panels to include in maintenance manuals.

1.6 QUALITY ASSURANCE

A. Installer Qualifications: An entity that employs installers and supervisors who are trained and approved by manufacturer.

B. UL-Certified, Portable Roll-Forming Equipment: UL-certified, portable roll-forming equipment capable of producing metal panels warranted by manufacturer to be the same as factory-formed products. Maintain UL certification of portable roll-forming equipment for duration of work.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Deliver components, metal panels, and other manufactured items so as not to be damaged or deformed. Package metal 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.

1.8 FIELD CONDITIONS

A. Weather Limitations: Proceed with installation only when existing and forecasted weather conditions permit assembly of metal panels to be performed according to manufacturers' written instructions and warranty requirements.

1.9 COORDINATION

A. Coordinate sizes and locations of roof curbs, and roof penetrations with actual equipment provided.

B. Coordinate metal panel installation with rain drainage work, flashing, trim, construction of soffits, and other adjoining work to provide a leakproof, secure, and noncorrosive installation.

1.10 WARRANTY

A. Special Warranty: Manufacturer's standard form in which 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's standard form in which manufacturer agrees to repair finish or replace metal panels that show evidence of deterioration of factory-applied finishes within specified warranty period.

1. Exposed Panel Finish: Deterioration includes, but is not limited to, the following:

a. Color fading more than 5 Delta E units when tested according to ASTM D2244.
b. Chalking in excess of a No. 8 rating when tested according to 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.

C. Special Weathertightness Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace standing-seam metal roof panel assemblies that fail to remain weathertight, including leaks, within specified warranty period.

1. Warranty Period: 20 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Structural Performance: Provide metal panel systems capable of withstanding the effects of the following loads, based on testing according to ASTM E1592:

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.

B. Air Infiltration: Air leakage of not more than 0.06 cfm/sq. ft. when tested according to ASTM E1680 at the following test-pressure difference:

1. Test-Pressure Difference: 6.24 lbf/sq. ft.

C. Water Penetration under Static Pressure: No water penetration when tested according to ASTM E1646 at the following test-pressure difference:

1. Test-Pressure Difference: 20 psf.

D. Wind-Uplift Resistance: Provide metal roof panel assemblies that comply with UL 580 for wind-uplift-resistance class indicated.

1. Uplift Rating: UL 90.
2. Fire/Windstorm Classification: Class 1A- 90.
3. Hail Resistance: MH.

E. Thermal Movements: Allow for thermal movements from ambient and surface temperature changes by preventing buckling, opening of joints, overstressing of components, failure of joint sealants, failure of connections, and other detrimental effects. Base calculations on surface temperatures of materials due to both solar heat gain and nighttime-sky heat loss.

1. Temperature Change (Range): 120 deg F, ambient; 180 deg F, material surfaces.

2.2 STANDING-SEAM METAL ROOF PANELS

A. Provide factory-formed metal roof panels designed to be installed by lapping and interconnecting raised side edges of adjacent panels with joint type indicated and mechanically

attaching panels to supports using concealed clips in side laps. Include clips, cleats, pressure plates, and accessories required for weathertight installation.

1. Steel Panel Systems: Unless more stringent requirements are indicated, comply with ASTM E1514.

B. Vertical-Rib, Seamed-Joint, Standing-Seam Metal Roof Panels (MTL-01 on Exterior Finish Legend in Drawings): Formed with vertical ribs at panel edges and a flat pan between ribs; designed for sequential installation by mechanically attaching panels to supports using concealed clips located under one side of panels, engaging opposite edge of adjacent panels, and mechanically seaming panels together.

1. Basis-of-Design Product: Berridge Manufacturing Company; Berridge Cee-Lock.

    a. Provide Basis-of-Design Product, or subject to compliance with requirements, provide a comparable product approved by Architect, by another manufacturer.

2. Metallic-Coated Steel Sheet: 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.

    a. Nominal Thickness: 0.022 inch (24 gauge).
    b. Exterior Finish: FEVE fluoropolymer.
    c. Color: As selected by Architect from manufacturer's full range.

3. Clips: One-piece fixed to accommodate thermal movement.

    a. 0.028-inch- nominal thickness, aluminum-zinc alloy-coated steel sheet.

4. Joint Type: Single folded.
5. Panel Coverage: 16-1/2 inches.
6. Panel Height: 2 inches.

2.3 UNDERLAYMENT MATERIALS

A. Self-Adhering, High-Temperature Underlayment: Provide self-adhering, cold-applied, sheet underlayment, a minimum of 30 mils thick, consisting of slip-resistant, polyethylene-film top surface laminated to a layer of butyl or SBS-modified asphalt adhesive, with release-paper backing. Provide primer when recommended by underlayment manufacturer.

1. Thermal Stability: Stable after testing at 240 deg F; ASTM D1970.
2. Low-Temperature Flexibility: Passes after testing at minus 20 deg F; ASTM D1970.
3. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

    a. GCP Applied Technologies Inc.
    b. Henry Company.
    c. Owens Corning.
    d. Protecto Wrap Company.

B. Slip Sheet: Manufacturer's recommended slip sheet, of type required for application.

2.4 MISCELLANEOUS MATERIALS

A. Miscellaneous Metal Subframing and Furring: ASTM C645; cold-formed, metallic-coated steel sheet, ASTM A653/A653M, G90 coating designation or ASTM A792/A792M, Class AZ50 coating designation unless otherwise indicated. Provide manufacturer's standard sections as required for support and alignment of metal panel system.

B. Panel Accessories: Provide components required for a complete, weathertight panel system including trim, copings, fasciae, mullions, sills, corner units, clips, flashings, sealants, gaskets, fillers, closure strips, and similar items. Match material and finish of metal panels unless otherwise indicated.

1. Closures: Provide closures at eaves and ridges, fabricated of same metal as metal panels.
2. Backing Plates: Provide metal backing plates at panel end splices, fabricated from material recommended 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 or necessary to ensure weathertight construction.

C. 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. Locations include, but are not limited to, eaves, rakes, corners, bases, framed openings, ridges, fasciae, and fillers. Finish flashing and trim with same finish system as adjacent metal panels.

D. Panel Fasteners: Self-tapping screws designed to withstand design loads.

E. Panel Sealants: Provide sealant type recommended 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

A. Fabricate and finish metal panels and accessories at the factory, by manufacturer's standard procedures and processes, as necessary to fulfill indicated performance requirements demonstrated by laboratory testing. Comply with indicated profiles and with dimensional and structural requirements.

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 according to equipment manufacturer's written instructions and to comply with details shown.

C. Provide panel profile for full length of panel.

D. 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.

E. Sheet Metal Flashing and Trim: Fabricate flashing and trim to comply with manufacturer's recommendations and recommendations in SMACNA's "Architectural Sheet Metal Manual" 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: Fabricate nonmoving seams in accessories with flat-lock seams. Tin edges to be seamed, form seams, and solder.
3. Sealed Joints: Form nonexpansion, but movable, joints in metal to accommodate sealant and to comply with SMACNA standards.
4. Conceal fasteners and expansion provisions where possible. Exposed fasteners are not allowed on faces of accessories exposed to view.
5. 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 by SMACNA's "Architectural Sheet Metal Manual" or metal 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. Steel Panels and Accessories:

1. FEVE Fluoropolymer: AAMA 621. Two-coat fluoropolymer finish 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.

2. Concealed Finish: Apply pretreatment and 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.

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 primary and secondary roof framing to verify that rafters, purlins, angles, channels, and other structural panel support members and anchorages have been installed within alignment tolerances required by metal roof panel manufacturer.
2. Examine solid roof sheathing to verify that sheathing joints are supported by framing or blocking and that installation is within flatness tolerances required by metal roof 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 subframing, furring, and other miscellaneous panel support members and anchorages according to ASTM C754 and metal panel manufacturer's written recommendations.

3.3 INSTALLATION OF UNDERLAYMENT

A. Self-Adhering Sheet Underlayment: Apply primer if required by manufacturer. Comply with temperature restrictions of underlayment manufacturer for installation. Apply at locations indicated below, wrinkle free, in shingle fashion to shed water, and with end laps of not less than 6 inches staggered 24 inches between courses. Overlap side edges not less than 3-1/2 inches. Roll laps with roller. Cover underlayment within 14 days.

1. Apply over the roof area indicated below:

    a. Roof perimeter for a distance up from eaves of 36 inches beyond interior wall line.
    b. Roof-to-wall intersections for a distance from wall of 18 inches.

B. Slip Sheet: Apply slip sheet over underlayment before installing metal roof panels.

C. Flashings: Install flashings to cover underlayment to comply with requirements specified in Section 07 6200 "Sheet Metal Flashing and Trim."

3.4 INSTALLATION OF STANDING SEAM METAL ROOF PANELS

A. Install metal panels according to 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 bottoms of 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. Fasteners:

1. Steel Panels: Use stainless steel fasteners for surfaces exposed to the exterior; use galvanized-steel fasteners for surfaces exposed to the interior.

C. Anchor Clips: Anchor metal roof panels and other components of the Work securely in place, using manufacturer's approved fasteners according to manufacturers' written instructions.

D. Metal Protection: Where dissimilar metals contact each other or corrosive substrates, protect against galvanic action as recommended in writing by metal panel manufacturer.

E. Standing-Seam Metal Roof Panel Installation: Fasten metal roof panels to supports with concealed clips at each standing-seam joint at location, spacing, and with fasteners recommended in writing by manufacturer.

1. Install clips to supports with self-tapping fasteners.
2. Install pressure plates at locations indicated in manufacturer's written installation instructions.
3. Seamed Joint: Crimp standing seams with manufacturer-approved, motorized seamer tool so clip, metal roof panel, and factory-applied sealant are completely engaged.
4. Watertight Installation:

a. Apply a continuous ribbon of sealant or tape to seal joints of metal panels, using sealant or tape as recommend in writing by manufacturer as needed to make panels watertight.
b. Provide sealant or tape between panels and protruding equipment, vents, and accessories.
c. At panel splices, nest panels with minimum 6-inch end lap, sealed with sealant and fastened together by interlocking clamping plates.

F. Accessory Installation: Install accessories with positive anchorage to building and weathertight mounting, and provide for thermal expansion. Coordinate installation with flashings and other components.

1. Install components required for a complete metal panel system including trim, copings, corners, seam covers, flashings, sealants, gaskets, fillers, closure strips, and similar items. Provide types indicated by metal roof panel manufacturers; or, if not indicated, types recommended by metal roof panel manufacturer.

G. Flashing and Trim: Comply with performance requirements, manufacturer's written installation instructions, and SMACNA's "Architectural Sheet Metal Manual." Provide concealed fasteners where possible, and set units true to line and level as indicated. Install work with laps, joints, and seams that will be permanently watertight and weather resistant.

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 achieve waterproof and weather-resistant performance.
2. Expansion Provisions: Provide for thermal expansion of exposed flashing and trim. Space movement joints at a maximum of 10 feet with no joints allowed within 24 inches of corner or intersection. Where lapped expansion provisions cannot be used or would not be sufficiently weather resistant and waterproof, form expansion joints of intermeshing hooked flanges, not less than 1 inch deep, filled with mastic sealant (concealed within joints).

H. Pipe Flashing: Form flashing around pipe penetration and metal roof panels. Fasten and seal to metal roof panels as recommended by manufacturer.

3.5 ERECTION TOLERANCES

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

3.6 FIELD QUALITY CONTROL

A. Manufacturer's Field Service: Engage a factory-authorized service representative to test and inspect metal roof panel installation, including accessories. Report results in writing.

B. Remove and replace applications of metal roof panels where tests and inspections indicate that they do not comply with specified requirements.

C. Additional tests and inspections, at Contractor's expense, are performed to determine compliance of replaced or additional work with specified requirements.

D. Prepare test and inspection reports.

3.7 CLEANING AND PROTECTION

A. Remove temporary protective coverings and strippable films, if any, as metal panels are installed, unless otherwise indicated in manufacturer's written installation instructions. On completion of metal panel installation, clean finished surfaces as recommended by metal panel manufacturer. Maintain in a clean condition during construction.

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 4114

SECTION 07 4233 - PHENOLIC WALL AND SOFFIT PANELS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Exterior decorative solid phenolic wall and soffit panel system with concealed fasteners.
2. Accessories as required for a complete drained and ventilated rainscreen system.

B. Related Requirements:

1. Section 07 2726 “Fluid-Applied Membrane Air Barriers” for air barriers installed behind phenolic panels.
2. Section 07 6200 "Sheet Metal Flashing and Trim" for metal flashing and trim installed with paneling.

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. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for panels and accessories.

B. Shop Drawings:

1. Include fabrication and installation layouts of phenolic resin panels; details of edge conditions, joints, corners, anchorages, attachment assembly, trim, flashings, closures, and accessories; and special details.
2. Accessories: Include details of the flashing, trim, and anchorage, at a scale of not less than 1-1/2 inches per 12 inches.

C. Samples for Verification: For the following products, of sizes indicated, to verify color and finish selected.

1. Phenolic panel: 3-1/2 by 3-1/2 inches.

1.4 INFORMATIONAL SUBMITTALS

A. Qualification Data: For Installer.

1.5 CLOSEOUT SUBMITTALS

A. Maintenance Data: For panels to include in maintenance manuals.

1.6 QUALITY ASSURANCE

A. Installer Qualifications: An entity that employs installers and supervisors who are trained and approved by manufacturer.

B. Manufacturer's Field Services: Upon Owner's request, provide manufacturer's field service consisting of product use recommendations and periodic site visits for inspection of product installation in accordance with manufacturer's instructions.

C. Mockups: 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 for phenolic resin paneling including accessories.

a. Size: 48 inches long by 48 inches wide.

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.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Store paneling in a dry, well-ventilated, weathertight location according to manufacturer's written instructions.

1.7 FIELD CONDITIONS

A. Weather Limitations: Proceed with installation only when existing and forecasted weather conditions permit paneling installation and related work to be performed according to manufacturer's written instructions.

1.7 WARRANTY

A. Manufacturer to warrant material defects and manufacturing tolerances for a period of 10 years.

B. Installer to warrant installation defects for a period of 2 years. Repair or replace materials during warranty period at no cost to Owner.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Structural Performance: Provide metal panel systems capable of withstanding the effects of the following loads, based on testing according to ASTM E 330:

1. Wind Loads: As indicated on Drawings.
2. Other Design Loads: As indicated on Drawings.
3. Deflection Limits: For wind loads, no greater than 1/175 of the span.

B. Fire Performance:

1. Flame Spread/Smoke Developed: Class A tested to ASTM E84.
2. Ignition Temperature: Greater than 650 degrees F (350 degrees C) above ambient, tested to ASTM D1929.
3. Extended Surface Burn: Max Flame Front less than 10 feet, tested to ASTM E2768.
4. Wall assemblies shall not ignite when exposed to a radiant heat energy source, NFPA 268.
5. Wall assemblies shall meet performance requirements of NFPA 285.

2.2 WOOD LOOK PHENOLIC RESIN PANELS

A. Wood-Look Solid Phenolic Panel Cladding: Exterior solid phenolic overlapping cladding panel system matching appearance of wood paneling, with concealed fasteners and accessories as required for a complete drained and back-ventilated rainscreen system.

1. Basis of Design Product: Item E2 (Trespa – Pura NFC; PU02 Classic Oak Finish) on Finish Legend in Drawings.

B. Material: Solid panel manufactured using a combination of high pressure and temperature to create a flat panel created from thermosetting resins.

1. Panel Composition: Manufacturer’s standard fire-rated phenolic resin core with decorative wood-look face layer, UV resistant layer and removeable peel coat.
2. Panel Size: 120 by 7.3 by 0.3 inches.
3. Fire Rating: Fire rated core and NFPA 285 approved assembly.
4. Facing: PU02 Classic Oak Finish.
5. Panel Thickness: 0.3 inches.
6. Joint Width: 0.3 inches.

2.3 PHENOLIC PANEL SUPPORT SYSTEM

A. Back Ventilated Rainscreen System: Provide back-ventilated rainscreen system installation complying with AAMA 509. Include attachment assembly components and accessories.

1. Basis-of-Design: Monarch Metal, Inc., or approved equal.

a. Provide Basis-of-Design product, or subject to compliance with requirements, an equivalent panel product, approved by Architect, from another manufacturer.

2. Fasteners (Concealed): Non-corrosive concealed fasteners and support clip system that allows for drainage and ventilation behind panels and as approved by panel manufacturer.

a. For concealed fastener attachment of the phenolic panel system designed to attach to the backside of the phenolic panel. Include all applicable components, including, but not limited to, the following:

1) Clips: Manufacturer’s recommended aluminum clips.

a) Basis of Design: Monarch Metal, Inc.; MFTP Clip.

2) Starter Rails: Manufacturer’s recommended ventilated aluminum rails.

a) Basis of Design: Monarch Metal, Inc.; MFTPSR Starter Rail

2.4 FABRICATION

A. Panels: Solid phenolic impregnated kraft paper wall panels with no voids, air spaces or foamed insulation in the core material. Accessory items in accordance with manufacturer's recommendations and approved submittals

B. Appearance: Panel lines, breaks, and angles shall be sharp, true, and surfaces free from warp and buckle.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Do not begin installation until substrates have been properly prepared.

1. Examine wall framing to verify that studs and other structural panel support members and anchorage have been installed within alignment tolerances required by metal wall panel manufacturer.
2. Examine wall sheathing to verify that sheathing joints are supported by framing or blocking and that installation is within flatness tolerances required by metal wall panel manufacturer.

a. Confirm that exterior sheathing is plumb and level, with no deflection greater than 1/4 inch in 20 feet.
b. Verify that air- or water-resistive barriers have been installed over sheathing or backing substrate to prevent air infiltration or water penetration.

B. Verify that panel style, color, and fasteners are approved by Architect.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Clean surfaces thoroughly prior to installation.

B. Prepare surfaces using the methods recommended by the manufacturer for achieving the best result for the substrate under the project conditions.

3.3 INSTALLATION

A. Install solid phenolic wall panels and sub-frame system in accordance with manufacturer's instructions.

B. Install solid phenolic wall panels plumb and level and accurately spaced in accordance with manufacturer's recommendations and approved submittals and drawings.

C. Anchor panels and sub-framing securely per engineering recommendations and in accordance with approved shop drawings to allow for necessary movement and structural support.

D. Fasten solid phenolic wall panels with fasteners approved for use with supporting substrate.

E. Do not install panels or component parts which are observed to be defective or damaged including, but not limited to: warped, bowed, abraded, scratched, and broken members.

F. Rainscreen-Principle Installation: Install using manufacturer's standard assembly with horizontal starter channels and vertical clips that provides support and secondary drainage assembly, draining at base of wall. Install vertical clips at locations, spacings, and with fasteners recommended by manufacturer. Leave horizontal and vertical joints with open reveal.

1. Do not apply sealants to joints unless otherwise indicated.

G. Do not cut or trim component parts during installation in a manner that would damage the finish, decrease the strength, or result in visual imperfection or a failure in performance. Return component parts with require alteration to the shop for re-fabrication or replacement.

H. Install corner trim with fasteners appropriate for use with adjoining construction as indicated on the Contract Drawings and as recommended by manufacturer.

I. Remove peelable protection coat after installation.

3.4 ADJUSTING AND CLEANING

A. Remove masking or panel protection as soon as possible after installation. Any masking intentionally left in place after panel installation on an elevation, shall become the responsibility of the General Contractor to remove.

B. Adjust final panel installation so that all joints are true and even throughout the installation. Panels out of plane shall be adjusted with the surrounding panels to minimize any imperfection.

C. Repair panels with minor damage. Remove and replace panels damaged beyond repair as a direct result of the panel installation. After installation, panel repair and replacement shall become the responsibility of the General Contractor.

D. Clean finished surfaces as recommended by panel manufacturer. After installation cleaning, cleaning during construction shall become the responsibility of the General Contractor.

END OF SECTION 07 4233

SECTION 07 5423 - THERMOPLASTIC-POLYOLEFIN (TPO) ROOFING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Adhered thermoplastic polyolefin (TPO) roofing system.
2. Vapor retarder.
3. Roof insulation.
4. Cover board.
5. Walkways.

B. Related Requirements:

1. Section 06 1053 "Rough Carpentry" for wood nailers, curbs, and blocking.
2. Section 07 6200 "Sheet Metal Flashing and Trim" for metal roof flashings and counterflashings.
3. Section 07 9200 "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 "The NRCA Roofing Manual: Membrane Roof Systems" apply to Work of this Section.

1.3 PREINSTALLATION MEETINGS

A. Preinstallation Roofing Conference: Conduct conference at Project site.

1. Meet with Owner, Architect, Owner's insurer if applicable, testing and inspecting agency representative, roofing 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. 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 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 flashings and membrane termination details.
3. Flashing details at penetrations.
4. Tapered insulation layout, thickness, and slopes.
5. Roof plan showing orientation of steel roof deck and orientation of roof membrane, fastening spacings, and patterns for mechanically fastened roofing system.
6. Insulation fastening patterns for corner, perimeter, and field-of-roof locations.
7. Tie-in with adjoining air barrier.

C. Samples for Verification: For the following products:

1. Roof membrane and flashing, of color required.

D. Wind Uplift Resistance Submittal: For roofing system, indicating compliance with wind uplift performance requirements.

1.5 INFORMATIONAL SUBMITTALS

A. Qualification Data: For Installer, manufacturer, and testing agency.

B. Manufacturer Certificates:

1. Performance Requirement Certificate: Signed by roof membrane manufacturer, certifying that roofing system complies with requirements specified in "Performance Requirements" Article.

a. Submit evidence of compliance with performance requirements.

2. Special Warranty Certificate: Signed by roof membrane manufacturer, certifying that all materials supplied under this Section are acceptable for special warranty.

C. Product Test Reports: For roof membrane and insulation, for tests performed by a qualified testing agency, indicating compliance with specified requirements.

D. Evaluation Reports: For components of roofing system, from ICC-ES.

E. Field quality-control reports.

F. Sample Warranties: For manufacturer's special warranties.

1.6 CLOSEOUT SUBMITTALS

A. Maintenance Data: For roofing system to include in maintenance manuals.

1.7 QUALITY ASSURANCE

A. Manufacturer Qualifications: A qualified manufacturer that is UL listed and listed in FM Approvals' RoofNav for roofing system identical to that used for this Project.

B. 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.

1.8 DELIVERY, STORAGE, AND HANDLING

A. Deliver roofing materials to Project site in original containers with seals unbroken and labeled with manufacturer's name, product brand name and type, date of manufacture, approval or listing agency markings, and directions for storing and mixing with other components.

B. Store liquid materials in their original undamaged containers in a clean, dry, protected location and within the temperature range required by roofing system manufacturer. Protect stored liquid material from direct sunlight.

1. Discard and legally dispose of liquid material that cannot be applied within its stated shelf life.

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

D. Handle and store roofing materials, and place equipment in a manner to avoid permanent deflection of deck.

1.9 FIELD CONDITIONS

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

1.10 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 includes roof membrane, base flashings, roof insulation, fasteners, cover boards, vapor retarder, and other components of roofing system.
2. Warranty Period: 20 years from date of Substantial Completion.

B. Special Project Warranty: Submit roofing Installer's warranty, covering the Work of this Section, including all components of roofing system such as roof membrane, base flashing, roof insulation, fasteners, cover boards, vapor retarders, and walkway products, for the following warranty period:

1. Warranty Period: Two years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. General Performance: Installed roofing system and flashings shall withstand specified uplift pressures, thermally induced movement, and exposure to weather without failure due to defective manufacture, fabrication, installation, or other defects in construction. Roof system and flashings shall remain watertight.

1. Accelerated Weathering: Roof membrane shall withstand 2000 hours of exposure when tested according to ASTM G152, ASTM G154, or ASTM G155.
2. Impact Resistance: Roof membrane shall resist impact damage when tested according to ASTM D3746, ASTM D4272, or the "Resistance to Foot Traffic Test" in FM Approvals 4470.

B. Material Compatibility: Roofing materials shall be compatible with one another and adjacent materials under conditions of service and application required, as demonstrated by roof membrane manufacturer based on testing and field experience.

C. FM Approvals' RoofNav Listing: Roof membrane, base flashings, and component materials shall comply with requirements in FM Approvals 4450 or FM Approvals 4470 as part of a roofing system, and shall be 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-90.

D. Exterior Fire-Test Exposure: ASTM E108 or UL 790, Class B; for application and roof slopes indicated; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.

2.2 THERMOPLASTIC POLYOLEFIN (TPO) ROOFING

A. TPO Sheet: ASTM D6878/D6878M, internally fabric- or scrim-reinforced, TPO sheet.

1. Manufacturers: Subject to compliance with requirements, provide roof assembly by one of the following Manufacturers:

a. Carlisle Syntec Systems.
b. Elevate.
c. Flex Membrane International Corp.
d. GAF.

2. Source Limitations: Obtain components for roofing system from roof membrane manufacturer or manufacturers approved by roof membrane manufacturer.
3. Thickness: 80 mils, nominal.
4. Exposed Face Color: White.

2.3 AUXILIARY ROOFING MATERIALS

A. General: Auxiliary materials recommended by roofing system manufacturer for intended use and compatible with other roofing components.

1. Adhesive and Sealants: Comply with VOC limits of authorities having jurisdiction and shall comply with the following limits for VOC content:

a. Plastic Foam Adhesives: 50 g/L.
b. Multipurpose Construction Adhesives: 70 g/L.
c. Fiberglass Adhesives: 80 g/L.
d. Contact Adhesives: 80 g/L.
e. PVC Welding Compounds: 510 g/L.
f. Other Adhesives: 250 g/L.
g. Single-Ply Roof Membrane Sealants: 450 g/L.
h. Nonmembrane Roof Sealants: 300 g/L.
i. Sealant Primers for Nonporous Substrates: 250 g/L.

B. Sheet Flashing: Manufacturer's standard unreinforced TPO sheet flashing, 55 mils thick, minimum, of same color as TPO sheet.

C. Prefabricated Pipe Flashings: As recommended by roof membrane manufacturer.

D. Bonding Adhesive: Manufacturer's standard.

E. Slip Sheet: Manufacturer's standard, of thickness required for application.

F. Metal Termination Bars: Manufacturer's standard, predrilled stainless steel or aluminum bars, approximately 1 by 1/8 inch thick; with anchors.

G. Fasteners: Factory-coated steel fasteners and metal or plastic plates complying with corrosion-resistance provisions in FM Approvals 4470, designed for fastening roofing components to substrate, and acceptable to roofing system manufacturer.

H. Miscellaneous Accessories: Provide pourable sealers, preformed cone and vent sheet flashings, preformed inside and outside corner sheet flashings, T-joint covers, lap sealants, termination reglets, and other accessories.

2.4 VAPOR RETARDER

A. Self-Adhering-Sheet Vapor Retarder: Polyethylene film laminated to layer of butyl rubber adhesive, minimum 30-mil total thickness; maximum permeance rating of 0.1 perm; cold applied, with slip-resisting surface and release paper backing. Provide primer when recommended by vapor retarder manufacturer.

2.5 ROOF INSULATION

A. General: Preformed roof insulation boards manufactured or approved by TPO roof membrane manufacturer, approved for use in FM Approvals' RoofNav listed roof assemblies.

B. Polyisocyanurate Board Insulation: ASTM C1289, Type II, Class 1, Grade 2, felt or glass-fiber mat facer on both major surfaces.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

    a. Carlisle SynTec Incorporated.
    b. Firestone Building Products.
    c. Flex Membrane International Corp.
    d. GAF.

2. Insulation: Factory-tapered insulation boards.
3. Compressive Strength: 25 psi.
4. Size: 48 by 48 inches.
5. Thickness: R-30 minimum and as required to attain slopes required for clear drainage.
6. Minimum Thickness: 1/4 inch.
7. 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.

2.6 INSULATION ACCESSORIES

A. General: Roof insulation accessories recommended by insulation manufacturer for intended use and compatibility with other roofing system components.

B. Fasteners: Factory-coated steel fasteners with metal or plastic plates complying with corrosion-resistance provisions in FM Approvals 4470, designed for fastening roof insulation and cover boards to substrate, and acceptable to roofing system manufacturer.

C. Insulation Adhesive: Insulation manufacturer's recommended adhesive formulated to attach roof insulation to substrate or to another insulation layer as follows:

1. Full-spread, spray-applied, low-rise, two-component urethane adhesive.
2. Adhesives and sealants shall comply with the following limits for VOC content:

a. Plastic Foam Adhesives: 50 g/L.
b. Gypsum Board and Panel Adhesives: 50 g/L.
c. Multipurpose Construction Adhesives: 70 g/L.
d. Fiberglass Adhesives: 80 g/L.
e. Contact Adhesives: 80 g/L.
f. PVC Welding Compounds: 510 g/L.
g. Other Adhesives: 250 g/L.
h. Single-Ply Roof Membrane Sealants: 450 g/L.
i. Nonmembrane Roof Sealants: 300 g/L.
j. Sealant Primers for Nonporous Substrates: 250 g/L.
k. Sealant Primers for Porous Substrates: 775 g/L.

D. Cover Board: ASTM C1177/C1177M, glass-mat, water-resistant gypsum board or ASTM C1278/C1278M fiber-reinforced gypsum board.

1. Products: Subject to compliance with requirements, provide one of the following:

a. Georgia-Pacific Gypsum LLC; Dens Deck Prime.
b. National Gypsum Company; DEXcell Glass Mat Roof Board.
c. USG Corporation; Securock Glass-Fiber Roof Board.

2. Thickness: 1/2 inch.
3. Surface Finish: Factory primed.

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: Approximately36 by 60 inches.
2. Color: Contrasting with roof membrane.

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 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.

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

3.2 PREPARATION

A. Clean substrate of dust, debris, moisture, and other substances detrimental to roofing system installation according to 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.

3.3 INSTALLATION OF ROOFING, GENERAL

A. Install roofing system according to roofing system manufacturer's written instructions.

1. Secure new and temporary construction, including equipment and accessories, so as to preclude wind blow-off and subsequent roof or equipment damage.
2. Install only as much roofing as can be made weathertight each day, including flashing and detail work. Clean seams and heat-weld before leaving jobsite.
3. Schedule and execute work without exposing interior building areas to effects of inclement weather. Protect existing building and its contents against all risks.
4. Install uninterrupted waterstops at end of each day's work and completely remove before proceeding with next day's work. Waterstops shall not emit dangerous or unsafe fumes and shall not remain in contact with finished roof as installation progresses. Replace contaminated membrane at no additional cost to Owner.
5. Avoid use of newly constructed roofing as walking surface or for equipment movement and storage. Where such access is required, provide necessary protection and barriers to segregate work area and to prevent damage to adjacent areas. Provide protection layer consisting of plywood over insulation board and roofing membrane for new and existing roof areas which receive rooftop traffic during construction.
6. Before and during application, remove dirt, debris, and dust from surfaces either by vacuuming, sweeping, blowing with compressed air, or similar methods.
7. Report rooftop contamination that is anticipated or that is occurring to Roofing Manufacturer to determine corrective steps to be taken.

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. Coordinate installation and transition of roofing system component serving as an air barrier with air barrier specified under Section 07 2726 "Fluid-Applied Membrane Air Barriers."

3.4 INSTALLATION OF VAPOR RETARDER

A. Self-Adhering-Sheet Vapor Retarder: Prime substrate if required by manufacturer. Install self-adhering-sheet vapor retarder over area to receive vapor retarder, side and end lapping each sheet a minimum of 3-1/2 and 6 inches, respectively.

1. Extend vertically up parapet walls and projections to a minimum height equal to height of insulation and cover board.
2. Seal laps by rolling.

B. Completely seal vapor retarder at terminations, obstructions, and penetrations to prevent air movement into roofing system.

3.5 INSTALLATION OF INSULATION

A. Coordinate installing roofing system components so insulation is not exposed to precipitation or left exposed at end of workday.

B. Comply with roofing system and roof insulation manufacturer's written instructions for installing roof insulation.

C. Installation Over Wood Decking:

1. Install vapor retarder.
2. Install base layer of insulation with joints staggered not less than 24 inches in adjacent rows.
    a. Trim insulation neatly to fit around penetrations and projections, and to fit tight to intersecting sloping roof decks.
    b. Make joints between adjacent insulation boards not more than 1/4 inch in width.
    c. 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.
        1) Trim insulation so that water flow is unrestricted.
    d. Fill gaps exceeding 1/4 inch with insulation.
    e. Cut and fit insulation within 1/4 inch of nailers, projections, and penetrations.
3. Mechanically attach base layer of insulation using mechanical fasteners specifically designed and sized for fastening specified board-type roof insulation to wood panel decks.
    a. Fasten insulation according to requirements in SPRI's Directory of Roof Assemblies for specified Wind Uplift Load Capacity.
    b. Fasten insulation to resist specified uplift pressure at corners, perimeter, and field of roof.
4. Install upper layers of insulation and tapered insulation with joints of each layer offset not less than 12 inches from previous layer of insulation.
    a. Staggered end joints within each layer not less than 24 inches in adjacent rows.
    b. Install with long joints continuous and with end joints staggered not less than 12 inches in adjacent rows.
    c. Trim insulation neatly to fit around penetrations and projections, and to fit tight to intersecting sloping roof decks.

d. Make joints between adjacent insulation boards not more than 1/4 inch in width.
e. 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.

1) Trim insulation so that water flow is unrestricted.

f. Fill gaps exceeding 1/4 inch with insulation.
g. Cut and fit insulation within 1/4 inch of nailers, projections, and penetrations.
h. Adhere each layer of insulation to substrate using adhesive according to SPRI's Directory of Roof Assemblies listed roof assembly requirements for specified Wind Uplift Load Capacity and FM Global Property Loss Prevention Data Sheet 1-29, as follows:

1) Set each layer of insulation in a uniform coverage of full-spread insulation adhesive, firmly pressing and maintaining insulation in place.

3.6 INSTALLATION OF COVER BOARDS

A. Install cover boards over insulation with long joints in continuous straight lines with end joints staggered between rows. Offset joints of insulation below a minimum of 6 inches in each direction.

1. Trim cover board neatly to fit around penetrations and projections, and to fit tight to intersecting sloping roof decks.
2. At internal roof drains, conform to slope of drain sump.

a. Trim cover board so that water flow is unrestricted.

3. Cut and fit cover board tight to nailers, projections, and penetrations.
4. Adhere cover board to substrate using adhesive according to FM Approvals' RoofNav listed roof assembly requirements for specified Windstorm Resistance Classification and FM Global Property Loss Prevention Data Sheet 1-29, as follows:

a. Set cover board in a uniform coverage of full-spread insulation adhesive, firmly pressing and maintaining insulation in place.

3.7 INSTALLATION OF ADHERED ROOF MEMBRANE

A. Adhere roof membrane over area to receive roofing according to roofing system manufacturer's written instructions.

B. Unroll roof membrane and allow to relax before installing.

C. Start installation of roofing in presence of roofing system manufacturer's technical personnel and Owner's testing and inspection agency.

D. Accurately align roof membrane, and maintain uniform side and end laps of minimum dimensions required by manufacturer. Stagger end laps.

E. Bonding Adhesive: Apply to substrate and underside of roof membrane at rate required by manufacturer, and allow to partially dry before installing roof membrane. Do not apply to splice area of roof membrane.

F. In addition to adhering, mechanically fasten roof membrane securely at terminations, penetrations, and perimeter of roofing.

G. Apply roof membrane with side laps shingled with slope of roof deck where possible.

H. Seams: Clean seam areas, overlap roof membrane, and hot-air weld side and end laps of roof membrane and sheet flashings, to ensure a watertight seam installation.

1. Test lap edges with probe to verify seam weld continuity. Apply lap sealant to seal cut edges of roof 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 roof membrane that do not comply with requirements.

I. Spread sealant bed over deck-drain flange at roof drains, and securely seal roof membrane in place with clamping ring.

3.8 INSTALLATION OF BASE FLASHING

A. Install sheet flashings and preformed flashing accessories, and adhere to substrates according to roofing system manufacturer's written instructions.

B. Apply bonding adhesive to substrate and underside of sheet flashing 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 with cured or uncured sheet flashing.

D. Clean seam areas, overlap, and firmly roll sheet flashings into the adhesive. Hot-air weld side and end laps to ensure a watertight seam installation.

E. Terminate and seal top of sheet flashings and mechanically anchor to substrate through termination bars.

3.9 INSTALLATION OF WALKWAYS

A. Flexible Walkways:

1. Install flexible walkways at the following locations:

a. Retain one or more subparagraphs below. Revise to suit Project.
b. Perimeter of each rooftop unit.
c. Between each rooftop unit location, creating a continuous path connecting rooftop unit locations.

d. Locations indicated on Drawings.
e. As required by roof membrane manufacturer's warranty requirements.

2. Provide 6-inch clearance between adjoining pads.
3. Heat weld to substrate or adhere walkway products to substrate with compatible adhesive according to roofing system manufacturer's written instructions.

3.10 FIELD QUALITY CONTROL

A. Testing Agency: Engage a qualified testing agency to perform tests and to inspect substrate conditions, surface preparation, roof membrane application, sheet flashings, protection, and drainage components, and to furnish reports to Architect.

1. Flood Testing: Flood test each roof area for leaks, according to recommendations in ASTM D5957, after completing roofing and flashing but before overlying construction is placed. Install temporary containment assemblies, plug or dam drains, and flood with potable water.

a. Perform tests before overlying construction is placed.
b. Flood to an average depth of 2-1/2 inches with a minimum depth of 1 inch and not exceeding a depth of 4 inches. Maintain 2 inches of clearance from top of base flashing.
c. Flood each area for 24 hours.
d. After flood testing, repair leaks, repeat flood tests, and make further repairs until roofing and flashing installations are watertight.

1) Cost of retesting is Contractor's responsibility.

e. Testing agency shall prepare survey report indicating locations of initial leaks, if any, and final survey report.

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.

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.

3.11 PROTECTING AND CLEANING

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.

1. Do whatever is necessary to minimize patches. If Owner determines that patching is excessive, Owner may require full replacement of the area in which the patching occurred.

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.

C. Clean overspray and spillage from adjacent construction using cleaning agents and procedures recommended by manufacturer of affected construction.

END OF SECTION 07 5423

SECTION 07 6200 - SHEET METAL FLASHING AND TRIM

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Formed roof-drainage sheet metal fabrications.
2. Formed low-slope roof sheet metal fabrications.
3. Formed steep-slope roof sheet metal fabrications.
4. Formed wall sheet metal fabrications.
5. Formed equipment support flashing.

B. Related Requirements:

1. Section 06 1000 " Rough Carpentry" for wood nailers, curbs, and blocking.
2. Section 07 5423 "Thermoplastic-Polyolefin (TPO) Roofing" for materials and installation of sheet metal flashing and trim integral with roofing.
3. Section 07 7200 "Roof Accessories" for set-on-type curbs, equipment supports and other manufactured roof accessory units.

1.2 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.

1.3 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.

1.4 ACTION SUBMITTALS

A. Product Data: For each of the following

1. Underlayment materials.
2. Elastomeric sealant.
3. Butyl sealant.

B. Shop Drawings: For sheet metal flashing and trim.

1. Include plans, elevations, sections, and attachment details.
2. Detail fabrication and installation layouts, expansion-joint locations, and keyed details. Distinguish between shop- and field-assembled Work.
3. Include identification of material, thickness, weight, and finish for each item and location in Project.
4. Include details for forming, including profiles, shapes, seams, and dimensions.
5. Include details for joining, supporting, and securing, including layout and spacing of fasteners, cleats, clips, and other attachments. Include pattern of seams.
6. Include details of termination points and assemblies.
7. Include details of roof-penetration flashing.
8. Include details of special conditions.
9. Include details of connections to adjoining work.
10. Detail formed flashing and trim at scale of not less than 1-1/2 inches per 12 inches.

C. Samples for Verification: For each type of exposed finish.

1. Sheet Metal Flashing: 12 inches long by actual width of unit, including finished seam and in required profile. Include fasteners, cleats, clips, closures, and other attachments.
2. Trim, Metal Closures, Expansion Joints, Joint Intersections, and Miscellaneous Fabrications: 12 inches long and in required profile. Include fasteners and other exposed accessories.

1.5 INFORMATIONAL SUBMITTALS

A. Qualification Data: For fabricator.

B. Product Certificates: For each type of coping and roof edge flashing that is ANSI/SPRI/FM 4435/ES-1 tested and FM Approvals approved.

C. Product Test Reports: For each product, for tests performed by a qualified testing agency.

D. Evaluation Reports: For copings and roof edge flashing, from ICC-ES showing compliance with ANSI/SPRI/FM 4435/ES-1.

E. Sample Warranty: For special warranty.

1.6 CLOSEOUT SUBMITTALS

A. Maintenance Data: For sheet metal flashing and trim, and its accessories, to include in maintenance manuals.

B. Special warranty.

1.7 QUALITY ASSURANCE

A. Fabricator Qualifications: 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.

1. For copings and roof edge flashings that are ANSI/SPRI/FM 4435/ES-1 tested and FM Approvals approved, shop shall be listed as able to fabricate required details as tested and approved.

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 edge at metal roof, 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.

1.9 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.

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, shall withstand wind loads, structural movement, thermally induced movement, and exposure to weather without failure due to defective manufacture, fabrication, installation, or other defects in construction. Completed sheet metal flashing and trim shall not rattle, leak, or loosen, and shall remain watertight.

B. Sheet Metal Standard for Flashing and Trim: Comply with NRCA's "The NRCA Roofing Manual: 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. Thermal Movements: Allow for thermal movements from ambient and surface temperature changes to prevent buckling, opening of joints, overstressing of components, failure of joint sealants, failure of connections, and other detrimental effects. Base calculations on surface temperatures of materials due to both solar heat gain and nighttime-sky heat loss.

1. Temperature Change: 120 deg F, ambient; 180 deg F, material surfaces.

2.2 SHEET METALS

A. Protect mechanical and other finishes on exposed surfaces from damage by applying strippable, temporary protective film before shipping.

B. Metallic-Coated Steel Sheet: Provide zinc-coated (galvanized) steel sheet in accordance with ASTM A653/A653M, G90 coating designation or aluminum-zinc alloy-coated steel sheet in accordance with ASTM A792/A792M, Class AZ50 coating designation, Grade 40; prepainted by coil-coating process to comply with ASTM A755/A755M.

1. Surface: Smooth, flat.
2. Exposed Coil-Coated Finish:

a. Two-Coat Fluoropolymer: AAMA 621. Fluoropolymer finish containing not less than 70 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.

3. Color: As selected by Architect from manufacturer's full range.

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 minimum total dry film thickness of 0.5 mil.

C. Stainless Steel Sheet: ASTM A240/A240M, Type 304, dead soft, fully annealed; with smooth, flat surface.

1. Finish: ASTM A480/A480M, No. 4 (polished directional satin).

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 MATERIALS

A. Felt: ASTM D226/D226M, Type II (No. 30), asphalt-saturated organic felt; nonperforated.

B. Self-Adhering, High-Temperature Sheet Underlayment: Minimum 30 mils thick, consisting of a slip-resistant polyethylene- or polypropylene-film top surface laminated to a layer of butyl- or SBS-modified asphalt adhesive, with release-paper backing; specifically designed to withstand high metal temperatures beneath metal roofing. Provide primer in accordance with underlayment manufacturer's written instructions.

1. Products: Subject to compliance with requirements, provide one of the following:

a. Carlisle WIP Products; a brand of Carlisle Construction Materials; WIP 300HT.
b. GCP Applied Technologies Inc.; Grace Ice and Water Shield HT.
c. Henry Company; Blueskin PE200 HT.
d. Metal-Fab Manufacturing, a Drexel Metals Company; MetShield.
e. Owens Corning; WeatherLock Metal High-Temperature Underlayment.
f. Protecto Wrap Company; Protecto Jiffy Seal Ice & Water Guard HT.

2. Source Limitations: Obtain underlayment from single source from single manufacturer.
3. Low-Temperature Flexibility: ASTM D1970/D1970M; passes after testing at minus 20 deg F or lower.

2.4 MISCELLANEOUS MATERIALS

A. Provide materials and types of fasteners, solder, 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 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.

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 Stainless Steel Sheet: Series 300 stainless steel.
3. Fasteners for Zinc-Coated (Galvanized) Steel Sheet: Series 300 stainless steel or hot-dip galvanized steel in accordance with ASTM A153/A153M or ASTM F2329.

C. Solder:

1. For Stainless Steel: ASTM B32, Grade Sn60, with acid flux of type recommended by stainless steel sheet manufacturer.
2. For Zinc-Coated (Galvanized) Steel: ASTM B32, Grade Sn50, 50 percent tin and 50 percent lead or Grade Sn60, 60 percent tin and 40 percent lead with maximum lead content of 0.2 percent.

D. 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.

E. Elastomeric Sealant: ASTM C920, elastomeric silicone polymer sealant; of type, grade, class, and use classifications required to seal joints in sheet metal flashing and trim and remain watertight.

F. Butyl Sealant: ASTM C1311, single-component, solvent-release butyl rubber sealant; polyisobutylene plasticized; heavy bodied for hooked-type expansion joints with limited movement.

G. Bituminous Coating: Cold-applied asphalt emulsion in accordance with ASTM D1187/D1187M.

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.

B. Fabrication Tolerances:

1. 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 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.

F. 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.

2.6 ROOF-DRAINAGE SHEET METAL FABRICATIONS

A. Hanging Gutters:

1. Fabricate to cross section required, complete with end pieces, outlet tubes, and other accessories as required.
2. Fabricate in minimum 96-inch-long sections.
3. Furnish flat-stock gutter brackets and flat-stock gutter spacers and straps fabricated from same metal as gutters, of size recommended by cited sheet metal standard, but with thickness not less than twice the gutter thickness.
4. Fabricate expansion joints, expansion-joint covers, gutter bead reinforcing bars, and gutter accessories from same metal as gutters. Shop fabricate interior and exterior corners.

5. Gutter Profile: Style B in accordance with cited sheet metal standard.
6. Expansion Joints: Butt type.
7. Accessories: Wire-ball downspout strainer.
8. Gutters with Girth up to 15 Inches: Fabricate from the following materials:

    a. Galvanized Steel: 0.022 inch thick.

B. Downspouts: Fabricate rectangular downspouts to dimensions indicated on Drawings, complete with mitered elbows. Furnish with metal hangers from same material as downspouts and anchors. Shop fabricate elbows.

1. Fabricated Hanger Style: Fig. 1-35A in accordance with SMACNA's "Architectural Sheet Metal Manual."
2. Fabricate from the following materials:

    a. Galvanized Steel: 0.022 inch thick.

2.7 LOW-SLOPE ROOF SHEET METAL FABRICATIONS

A. Copings: Fabricate in minimum 96-inch-long, but not exceeding 12-foot-long, sections. Fabricate joint plates of same thickness as copings. Furnish with continuous cleats to support edge of external leg and drill elongated holes for fasteners on interior leg. Miter corners, solder or weld watertight. Shop fabricate interior and exterior corners.

1. Coping Profile: As shown in Drawings and in accordance with SMACNA's "Architectural Sheet Metal Manual."
2. Joint Style: Butted with expansion space and 6-inch-wide, exposed cover plate.
3. Fabricate from the following materials:

    a. Galvanized Steel: 0.040 inch thick.

B. Base Flashing: Shop fabricate interior and exterior corners. Fabricate from the following materials:

1. Galvanized Steel: 0.028 inch thick.

C. Counterflashing: Shop fabricate interior and exterior corners. Fabricate from the following materials:

1. Galvanized Steel: 0.022 inch thick.

D. Flashing Receivers: Fabricate from the following materials:

1. Galvanized Steel: 0.022 inch thick

E. Roof-Penetration Flashing: Fabricate from the following materials:

1. Stainless Steel: 0.0188 inch thick.

F. Roof-Drain Flashing: Fabricate from the following materials:

1. Stainless Steel: 0.0156 inch thick.

2.8 STEEP-SLOPE ROOF SHEET METAL FABRICATIONS

A. Drip Edges: Fabricate from the following materials:

1. Galvanized Steel: 0.022 inch thick.

B. Eave, and Rake Flashing: Fabricate from the following materials:

1. Galvanized Steel: 0.022 inch thick.

C. Counterflashing: Shop fabricate interior and exterior corners. Fabricate from the following materials:

1. Galvanized Steel: 0.022 inch thick.

D. Flashing Receivers: Fabricate from the following materials:

1. Galvanized Steel: 0.022 inch thick.

E. Roof-Penetration Flashing: Fabricate from the following materials:

1. Galvanized Steel: 0.028 inch thick.

2.9 WALL SHEET METAL FABRICATIONS

A. Through-Wall Flashing: Fabricate continuous flashings in minimum 96-inch-long, but not exceeding 12-foot-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:

1. Stainless Steel: 0.0156 inch thick.

B. Opening Flashings in Frame Construction: 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:

1. Galvanized Steel: 0.022 inch thick.

2.10 SHEET METAL FABRICATIONS

A. Equipment Support Flashing: Fabricate from the following materials:

1. Galvanized Steel: 0.028 inch thick.

B. Break Metal Filler: Fabricate from the following materials:

1. Galvanized Steel: 0.040 inch thick.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions, with installer present, for compliance with requirements for installation tolerances, substrate, and other conditions affecting performance of the Work.

1. Verify compliance with requirements for installation tolerances of substrates.
2. Verify that substrate is sound, dry, smooth, clean, sloped for drainage, and securely anchored.
3. Verify that air- or water-resistant barriers have been installed over sheathing or backing substrate to prevent air infiltration or water penetration.

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

3.2 INSTALLATION OF UNDERLAYMENT

A. 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.

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. 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, 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, solder, 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 solder.
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. Space individual cleats not more than 12 inches apart. Attach each cleat with at least two fasteners. Bend tabs over fasteners.
6. Install exposed sheet metal flashing and trim with limited oil-canning, and free of buckling and tool marks.
7. Do not field cut sheet metal flashing and trim by torch.

B. Metal Protection: Where dissimilar metals contact each other, or where metal contacts pressure-treated wood or other corrosive substrates, protect against galvanic action or corrosion by painting contact surfaces with bituminous coating or by other permanent separation as recommended by sheet metal manufacturer or cited sheet metal standard.

1. Coat concealed side of stainless steel sheet metal flashing and trim with bituminous coating where flashing and trim contact wood, ferrous metal, or cementitious construction.
2. Underlayment: Where installing sheet metal flashing and trim directly on cementitious or wood substrates, install underlayment and cover with slip sheet.

C. Expansion Provisions: Provide for thermal expansion of exposed flashing and trim.

1. Space movement joints at maximum of 10 feet 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 wood blocking or sheathing not less than 1-1/4 inches for nails and not less than 3/4 inch for wood screws.

E. Conceal fasteners and expansion provisions where possible in exposed work and locate to minimize possibility of leakage. Cover and seal fasteners and anchors as required for a tight installation.

F. Seal joints as required for watertight construction.

1. Use sealant-filled joints unless otherwise indicated.

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 07 9200 "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 sheet.
3. Do not use torches for soldering.
4. Heat surfaces to receive solder, and flow solder into joint.

a. Fill joint completely.
b. Completely remove flux and spatter from exposed surfaces.

5. 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.

3.4 INSTALLATION OF ROOF-DRAINAGE SYSTEM

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 riveted and soldered joints.
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 gutter with gutter brackets spaced not more than 24 inches apart to roof deck unless otherwise indicated, and loosely lock to front gutter bead.
9. Install gutter with expansion joints at locations indicated on Drawings, but not exceeding, 50 feet 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.

3.5 INSTALLATION OF ROOF FLASHINGS

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. Copings:

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.

    a. Interlock exterior bottom edge of coping with continuous cleat anchored to substrate at 16-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.

C. 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.

D. 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.

E. Roof-Penetration Flashing: Coordinate installation of roof-penetration flashing with installation of roofing and other items penetrating roof. Seal with elastomeric or butyl sealant and clamp flashing to pipes that penetrate roof.

3.6 INSTALLATION OF WALL FLASHINGS

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 FLASHING

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.

3.8 INSTALLATION TOLERANCES

A. Installation Tolerances: Shim and align sheet metal flashing and trim within installed tolerance of 1/4 inch in 20 feet on slope and location lines indicated on Drawings and within 1/8-inch offset of adjoining faces and of alignment of matching profiles.

3.9 CLEANING

A. Clean exposed metal surfaces of substances that interfere with uniform oxidation and weathering.

B. Clean and neutralize flux materials. Clean off excess solder.

C. Clean off excess sealants.

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 6200

SECTION 07 7200 - ROOF ACCESSORIES

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Equipment supports.
2. Roof hatches.

B. Related Requirements:

1. Section 05 5000 "Metal Fabrications" for metal vertical ladders for access to roof hatches.
2. Section 07 6200 "Sheet Metal Flashing and Trim" for shop- and field-formed metal flashing, roof-drainage systems, and miscellaneous sheet metal trim and accessories.

1.2 COORDINATION

A. Coordinate layout and installation of roof accessories with roofing membrane and base flashing and interfacing and adjoining construction to provide a leakproof, weathertight, secure, and noncorrosive installation.

B. Coordinate dimensions with rough-in information or Shop Drawings of equipment to be supported.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of roof accessory.

1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes.

B. Shop Drawings: For roof accessories.

1. Include plans, elevations, keyed details, and attachments to other work. Indicate dimensions, loadings, and special conditions. Distinguish between plant- and field-assembled work.

C. Samples: For each exposed product and for each color and texture specified, prepared on Samples of size to adequately show color.

D. Delegated-Design Submittal: For equipment supports indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

1. Detail mounting, securing, and flashing of roof-mounted items to roof structure. Indicate coordinating requirements with roof membrane system.
2. Wind-Restraint Details: Detail fabrication and attachment of wind restraints. Show anchorage details and indicate quantity, diameter, and depth of penetration of anchors.

1.4 INFORMATIONAL SUBMITTALS

A. Coordination Drawings: Roof plans, drawn to scale, and coordinating penetrations and roof-mounted items. Show the following:

1. Size and location of roof accessories specified in this Section.
2. Method of attaching roof accessories to roof or building structure.
3. Other roof-mounted items including mechanical and electrical equipment, ductwork, piping, and conduit.
4. Required clearances.

B. Sample Warranties: For manufacturer's special warranties.

1.5 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For roof accessories to include in operation and maintenance manuals.

1.6 WARRANTY

A. Special Warranty on Painted Finishes: Manufacturer's standard form in which manufacturer agrees to repair finishes or replace roof accessories 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 according to ASTM D2244.
b. Chalking in excess of a No. 8 rating when tested according to 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 accessories shall withstand exposure to weather and resist thermally induced movement without failure, rattling, leaking, or fastener disengagement due to defective manufacture, fabrication, installation, or other defects in construction.

B. Delegated Design: Engage a qualified professional engineer, as defined in Section 01 4000 "Quality Requirements," to design equipment supports to comply with wind performance requirements, including comprehensive engineering analysis by a qualified professional engineer, using performance requirements and design criteria indicated.

C. Wind-Restraint Performance: As indicated on Drawings.

2.2 EQUIPMENT SUPPORTS

A. Equipment Supports: Internally reinforced perimeter metal equipment supports capable of supporting superimposed live and dead loads between structural supports, including equipment loads and other construction indicated on Drawings, spanning between structural supports; capable of meeting performance requirements; with welded or mechanically fastened and sealed corner joints, stepped integral metal cant raised the thickness of roof insulation, and integrally formed structure-mounting flange at bottom.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Adaptable Air Products.
b. AES Industries, Inc.
c. Air Balance; a division of MESTEK, Inc.
d. Conn-Fab Sales, Inc.
e. Custom Solution Roof and Metal Products.
f. Greenheck Fan Corporation.
g. Lloyd Industries, Inc.
h. LMCurbs.
i. Louvers & Dampers, Inc.; a division of Mestek, Inc.
j. Milcor; Commercial Products Group of Hart & Cooley, Inc.

B. Size: Coordinate dimensions with roughing-in information or Shop Drawings of equipment to be supported.

C. Supported Load Capacity: Coordinate load capacity with information on Shop Drawings of equipment to be supported.

D. Material: Zinc-coated (galvanized) steel sheet, 0.079 inch thick.

1. Finish: Two-coat fluoropolymer.
2. Color: As selected by Architect from manufacturer's full range.

E. Construction:

1. Curb Profile: Manufacturer's standard compatible with roofing system.
2. Insulation: Factory insulated with 1-1/2-inch- thick glass-fiber board insulation.
3. Liner: Same material as equipment support, of manufacturer's standard thickness and finish.
4. Nailer: Factory-installed continuous wood nailers 5-1/2 inches wide on top flange of equipment supports, continuous around support perimeter.
5. Wind Restraint Straps and Base Flange Attachment: Provide wind restraint straps, welded strap connectors, and base flange attachment to roof structure at perimeter of curb of size and spacing required to meet wind uplift requirements.
6. Platform Cap: Where portion of equipment support is not covered by equipment, provide weathertight platform cap formed from 3/4-inch-thick plywood covered with metal sheet of same type, thickness, and finish as required for curb.
7. Metal Counterflashing: Manufacturer's standard, removable, fabricated of same metal and finish as equipment support.
8. On ribbed or fluted metal roofs, form deck-mounting flange at perimeter bottom to conform to roof profile.
9. Fabricate equipment supports to minimum height of 12 inches above roofing surface unless otherwise indicated.

2.3 ROOF HATCHES

A. Roof Hatches: Metal roof-hatch units with lids and insulated single-walled curbs, welded or mechanically fastened and sealed corner joints, continuous lid-to-curb counterflashing and weathertight perimeter gasketing, straight sides, and integrally formed deck-mounting flange at perimeter bottom.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

    a. Acudor Products, Inc.
    b. Babcock-Davis.
    c. BILCO Company (The).
    d. JL Industries, Inc.; a division of the Activar Construction Products Group.
    e. Kingspan Light + Air, North America.
    f. Milcor; Commercial Products Group of Hart & Cooley, Inc.
    g. Nystrom.
    h. Precision Ladders, LLC.
    i. Williams Bros. Corporation of America (The).

B. Type and Size: Single-leaf lid hatch of size indicated.

C. Loads: Minimum 40-lbf/sq. ft. external live load and 20-lbf/sq. ft. internal uplift load.

D. Hatch Material: Zinc-coated (galvanized) steel sheet.

1. Thickness: Manufacturer's standard thickness for hatch size indicated.
2. Finish: Two-coat fluoropolymer.

3. Color: As selected by Architect from manufacturer's full range.

E. Construction:

1. Insulation: 2-inch-thick, polyisocyanurate board.

a. R-Value: 12.0 according to ASTM C1363.

2. Nailer: Factory-installed wood nailer continuous around hatch perimeter.
3. Hatch Lid: Opaque, insulated, and double walled, with manufacturer's standard metal liner of same material and finish as outer metal lid.
4. Curb Liner: Manufacturer's standard, of same material and finish as metal curb.
5. On ribbed or fluted metal roofs, form flange at perimeter bottom to conform to roof profile.
6. Fabricate curbs to minimum height of 12 inches above roofing surface unless otherwise indicated.

F. Hardware: Spring operators, hold-open arm, stainless steel spring latch with turn handles, stainless steel butt- or pintle-type hinge system, and padlock hasps inside and outside.

1. Provide two-point latch on lids larger than 84 inches.

G. Ladder-Assist Post: Roof-hatch manufacturer's standard device for attachment to roof-access ladder.

1. Operation: Post locks in place on full extension; release mechanism returns post to closed position.
2. Height: 42 inches above finished roof deck.
3. Material: Stainless steel.
4. Post: 1-5/8-inch- diameter pipe.
5. Finish: Manufacturer's standard baked enamel or powder coat.

2.4 METAL MATERIALS

A. Zinc-Coated (Galvanized) Steel Sheet: ASTM A653/A653M, G90 coating designation.

1. 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 621. System consisting of primer and fluoropolymer color topcoat containing not less than 70 percent polyvinylidene fluoride (PVDF) resin by weight.

2. Concealed Finish: Pretreat with manufacturer's standard white or light-colored acrylic or polyester-backer finish consisting of prime coat and wash coat, with a minimum total dry film thickness of 0.5 mil.

B. Stainless Steel Sheet and Shapes: ASTM A240/A240M or ASTM A666, Type 304.

C. Steel Shapes: ASTM A36/A36M, hot-dip galvanized according to ASTM A123/A123M unless otherwise indicated.

D. Galvanized-Steel Tube: ASTM A500/A500M, round tube, hot-dip galvanized according to ASTM A123/A123M.

2.5 MISCELLANEOUS MATERIALS

A. Provide materials and types of fasteners, protective coatings, sealants, and other miscellaneous items required by manufacturer for a complete installation.

B. Polyisocyanurate Board Insulation: ASTM C1289, thickness and thermal resistivity as indicated.

C. Wood Nailers: Softwood lumber, pressure treated with waterborne preservatives for aboveground use, acceptable to authorities having jurisdiction, containing no arsenic or chromium, and complying with AWPA C2; not less than 1-1/2 inches thick.

D. Underlayment:

1. Felt: ASTM D226/D226M, Type II (No. 30), asphalt-saturated organic felt, nonperforated.
2. Slip Sheet: Building paper, 3 lb/100 sq. ft. minimum, rosin sized.
3. Self-Adhering, High-Temperature Sheet: Minimum 30 to 40 mils thick, consisting of slip-resisting polyethylene-film top surface laminated to layer of butyl or SBS-modified asphalt adhesive, with release-paper backing; cold applied. Provide primer when recommended by underlayment manufacturer.

E. Fasteners: Roof accessory manufacturer's recommended fasteners suitable for application and metals being fastened. Match finish of exposed fasteners with finish of material being fastened. Provide nonremovable fastener heads to exterior exposed fasteners. Furnish the following unless otherwise indicated:

1. Fasteners for Zinc-Coated or Aluminum-Zinc Alloy-Coated Steel: Series 300 stainless steel or hot-dip zinc-coated steel according to ASTM A153/A153M or ASTM F2329.

F. 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.

G. Elastomeric Sealant: ASTM C920, elastomeric silicone polymer sealant as recommended by roof accessory manufacturer for installation indicated; low modulus; of type, grade, class, and use classifications required to seal joints and remain watertight.

H. Butyl Sealant: ASTM C1311, single-component, solvent-release butyl rubber sealant; polyisobutylene plasticized; heavy bodied for expansion joints with limited movement.

2.6 GENERAL FINISH REQUIREMENTS

A. Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.

B. Appearance of Finished Work: Noticeable variations in same piece are not acceptable. Variations in appearance of adjoining components are acceptable if they are within 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. Verify that substrate is sound, dry, smooth, clean, sloped for drainage, and securely anchored.

C. Verify dimensions of roof openings for roof accessories.

D. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Install roof accessories according to manufacturer's written instructions.

1. Install roof accessories level; plumb; true to line and elevation; and without warping, jogs in alignment, buckling, or tool marks.
2. Anchor roof accessories securely in place so they are capable of resisting indicated loads.
3. Use fasteners, separators, sealants, and other miscellaneous items as required to complete installation of roof accessories and fit them to substrates.
4. Install roof accessories to resist exposure to weather without failing, rattling, leaking, or loosening of fasteners and seals.

B. Equipment Support Installation: Install equipment supports so top surfaces are level with each other.

C. Roof-Hatch Installation:

1. Verify that roof hatch operates properly. Clean, lubricate, and adjust operating mechanism and hardware.
2. Attach ladder-assist post according to manufacturer's written instructions.

D. Seal joints with elastomeric or butyl sealant as required by roof accessory manufacturer.

3.3 REPAIR AND CLEANING

A. Galvanized Surfaces: Clean field welds, bolted connections, and abraded areas and repair galvanizing according to ASTM A780/A780M.

B. Clean exposed surfaces according to manufacturer's written instructions.

C. Clean off excess sealants.

D. Replace roof accessories that have been damaged or that cannot be successfully repaired by finish touchup or similar minor repair procedures.

END OF SECTION 07 7200

SECTION 07 9200 - JOINT SEALANTS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Nonstaining silicone joint sealants.
2. Urethane joint sealants.
3. Silyl-terminated polyether joint sealants.
4. Mildew-resistant joint sealants.
5. Butyl joint sealants.
6. Latex joint sealants.

B. Related Requirements:

1. Section 07 9219 "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 joint-sealant product.

B. Samples for Initial Selection: Manufacturer's 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 kind 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.

1.4 INFORMATIONAL SUBMITTALS

A. Qualification Data: For qualified testing agency.

B. Product Test Reports: For each kind of joint sealant, for tests performed by a qualified testing agency.

C. Field-Adhesion-Test Reports: For each sealant application tested.

D. Sample Warranties: For special warranties.

1.5 QUALITY ASSURANCE

A. Installer Qualifications: An authorized representative who is trained and approved by manufacturer.

B. Product Testing: Test joint sealants using a qualified testing agency.

1. Testing Agency Qualifications: Qualified according to ASTM C1021 to conduct the testing indicated.

C. Mockups: Install sealant in mockups of assemblies specified in other Sections that are indicated to receive joint sealants specified in this Section. Use materials and installation methods specified in this Section.

D. Where conflicting information is found in the Construction Documents related to products, details or dimensional discrepancies, comply with the most stringent requirements regardless of cost.

1.6 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.

1.7 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 JOINT SEALANTS, GENERAL

A. Compatibility: Provide joint sealants, backings, and other related materials that are compatible with one another and with joint substrates under conditions of service and application, as demonstrated by joint-sealant manufacturer, based on testing and field experience.

B. VOC Content: Sealants and sealant primers shall comply with the following:

1. Architectural sealants shall have a VOC content of 250 g/L or less.
2. Sealants and sealant primers for nonporous substrates shall have a VOC content of 250 g/L or less.
3. Sealants and sealant primers for porous substrates shall have a VOC content of 775 g/L or less.

C. Colors of Exposed Joint Sealants: As selected by Architect from manufacturer's full range.

2.2 NONSTAINING SILICONE JOINT SEALANTS

A. Nonstaining Joint Sealants: No staining of substrates when tested according to ASTM C1248.

B. Silicone, Nonstaining, S, NS, 50, NT: Nonstaining, single-component, nonsag, plus 50 percent and minus 50 percent movement capability, nontraffic-use, neutral-curing silicone joint sealant; ASTM C920, Type S, Grade NS, Class 50, Use NT.

1. Products: Subject to compliance with requirements, provide one of the following:

a. GE Construction Sealants; Momentive Performance Materials Inc.; Silpruf NB.
b. Sika Corporation; Joint Sealants; Sikasil WS-295.

c. The Dow Chemical Company; DOW CORNING® 756 SMS BUILDING SEALANT.

2.3 URETHANE JOINT SEALANTS

A. Urethane, S, NS, 25, T, NT: Single-component, nonsag, plus 25 percent and minus 25 percent movement capability, traffic- and nontraffic-use, urethane joint sealant; ASTM C920, Type S, Grade NS, Class 25, Uses T and NT.

1. Products: Subject to compliance with requirements, provide one of the following:

a. BASF Corporation; MasterSeal NP 1 (Pre-2014: Sonolastic NP1).
b. LymTal International Inc; Iso-Flex 330.

B. Urethane, S, P, 25, T, NT: Single-component, pourable, plus 25 percent and minus 25 percent movement capability, traffic- and nontraffic-use, urethane joint sealant; ASTM C920, Type S, Grade P, Class 25, Uses T and NT.

1. Products: Subject to compliance with requirements, provide one of the following:

a. BASF Corporation; MasterSeal SL 1 (Pre-2014: Sonolastic SL1).
b. Pecora Corporation; NR-201.
c. Polymeric Systems, Inc; Flexiprene 952.

C. Urethane, M, NS, 25, T, NT: Multicomponent, nonsag, plus 25 percent and minus 25 percent movement capability, traffic- and nontraffic-use, urethane joint sealant; ASTM C920, Type M, Grade NS, Class 25, Uses T and NT.

1. Products: Subject to compliance with requirements, provide one of the following:

a. BASF Corporation; MasterSeal NP 2 (Pre-2014: Sonolastic NP2).
b. Bostik, Inc; Chem-Calk 505.
c. Pecora Corporation; Dynatred.
d. Sika Corporation; Joint Sealants; Sikaflex 2c NS EZ Mix.

2.4 SILYL-TERMINATED POLYETHER (STPE) JOINT SEALANTS

A. STPE, S, NS, 50, NT: Single-component, nonsag, plus 50 percent and minus 50 percent movement capability, nontraffic-use, silyl-terminated polyether joint sealant; ASTM C920, Type S, Grade NS, Class 50, Use NT.

1. Products: Subject to compliance with requirements, provide one of the following:

a. GE Construction Sealants; Momentive Performance Materials Inc.; SCS7000.
b. Pecora Corporation; DynaTrol I-XL Tru-White.
c. Sika Corporation; Joint Sealants; SikaHyflex-150 LM.

2.5 MILDEW-RESISTANT JOINT SEALANTS

A. Mildew-Resistant Joint Sealants: Formulated for prolonged exposure to humidity with fungicide to prevent mold and mildew growth.

B. Silicone, Mildew Resistant, Acid Curing, S, NS, 25, NT: Mildew-resistant, single-component, nonsag, plus 25 percent and minus 25 percent movement capability, nontraffic-use, acid-curing silicone joint sealant; ASTM C920, Type S, Grade NS, Class 25, Use NT.

1. Products: Subject to compliance with requirements, provide one of the following:

    a. GE Construction Sealants; Momentive Performance Materials Inc.; SCS1700 Sanitary.
    b. Pecora Corporation; Pecora 860.
    c. Soudal USA; RTV GP.
    d. The Dow Chemical Company; DOW CORNING® 786 SILICONE SEALANT -.

2.6 BUTYL JOINT SEALANTS

A. Butyl-Rubber-Based Joint Sealants: ASTM C1311.

1. Products: Subject to compliance with requirements, provide one of the following:

    a. Bostik, Inc; Chem-Calk 300.
    b. Pecora Corporation; BC-158.

2.7 LATEX JOINT SEALANTS

A. Acrylic Latex: Acrylic latex or siliconized acrylic latex, ASTM C834, Type OP, Grade NF.

1. Products: Subject to compliance with requirements, provide one of the following:

    a. Everkem Diversified Products, Inc.; SilTex 40 Siliconized Acryllic Latex Caulk.
    b. Franklin International; Titebond Painter's Plus Caulk.
    c. Pecora Corporation; AC-20.

2.8 JOINT-SEALANT BACKING

A. Sealant Backing Material, General: Nonstaining; compatible with joint substrates, sealants, primers, and other joint fillers; and approved for applications indicated by sealant manufacturer based on field experience and laboratory testing.

1. Products: Subject to compliance with requirements, provide one of the following:

    a. Adfast; Adseal BR 2600.
    b. Alcot Plastics Ltd.; ALCOT Soft Type Backer Rod.
    c. BASF Corporation; MasterSeal 920 & 921(Pre-2014: Sonolastic Backer Rod).

B. Cylindrical Sealant Backings: ASTM C1330, Type C (closed-cell material with a surface skin), and of size and density to control sealant depth and otherwise contribute to producing optimum sealant performance.

C. Bond-Breaker Tape: Polyethylene tape or other plastic tape recommended by sealant manufacturer for preventing sealant from adhering to rigid, inflexible joint-filler materials or joint surfaces at back of joint. Provide self-adhesive tape where applicable.

2.9 MISCELLANEOUS MATERIALS

A. Primer: Material recommended by joint-sealant manufacturer where required for adhesion of sealant to joint substrates indicated, as determined from preconstruction joint-sealant-substrate tests and field tests.

B. Cleaners for 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. Clean porous joint substrate surfaces by brushing, grinding, mechanical abrading, or a combination of these methods to produce a clean, sound substrate capable of developing optimum bond with joint sealants. Remove loose particles remaining after cleaning operations above by vacuuming or blowing out joints with oil-free compressed air. Porous joint substrates include the following:

a. Concrete.
b. Unglazed surfaces of ceramic tile.

3. Remove laitance and form-release agents from concrete.
4. Clean nonporous joint substrate surfaces with chemical cleaners or other means that do not stain, harm substrates, or leave residues capable of interfering with adhesion of joint sealants. Nonporous joint substrates include the following:

a. Metal.
b. Glass.
c. Porcelain enamel.
d. Glazed surfaces of ceramic tile.

B. Joint Priming: Prime joint substrates where recommended by joint-sealant manufacturer or as indicated by preconstruction joint-sealant-substrate tests or prior experience. Apply primer to comply with joint-sealant manufacturer's written instructions. Confine primers to areas of joint-sealant bond; do not allow spillage or migration onto adjoining surfaces.

C. Masking Tape: Use masking tape where required to prevent contact of sealant or primer with adjoining surfaces that otherwise would be permanently stained or damaged by such contact or by cleaning methods required to remove sealant smears. Remove tape immediately after tooling without disturbing joint seal.

3.3 INSTALLATION OF JOINT SEALANTS

A. General: Comply with joint-sealant manufacturer's written installation instructions for products and applications indicated, unless more stringent requirements apply.

B. Sealant Installation Standard: Comply with recommendations in ASTM C1193 for use of joint sealants as applicable to materials, applications, and conditions indicated.

C. Install sealant backings of kind indicated to support sealants during application and at position required to produce cross-sectional shapes and depths of installed sealants relative to joint widths that allow optimum sealant movement capability.

1. Do not leave gaps between ends of sealant backings.
2. Do not stretch, twist, puncture, or tear sealant backings.
3. Remove absorbent sealant backings that have become wet before sealant application, and replace them with dry materials.

D. Install bond-breaker tape behind sealants where sealant backings are not used between sealants and backs of joints.

E. Install sealants using proven techniques that comply with the following and at the same time backings are installed:

1. Place sealants so they directly contact and fully wet joint substrates.
2. Completely fill recesses in each joint configuration.

3. Produce uniform, cross-sectional shapes and depths relative to joint widths that allow optimum sealant movement capability.

F. Tooling of Nonsag Sealants: Immediately after sealant application and before skinning or curing begins, tool sealants according to requirements specified in subparagraphs below to form smooth, uniform beads of configuration indicated; to eliminate air pockets; and to ensure contact and adhesion of sealant with sides of joint.

1. Remove excess sealant from surfaces adjacent to joints.
2. Use tooling agents that are approved in writing by sealant manufacturer and that do not discolor sealants or adjacent surfaces.
3. Provide concave joint profile per Figure 8A in ASTM C1193 unless otherwise indicated.
4. Provide flush joint profile at locations indicated on Drawings according to Figure 8B in ASTM C1193.
5. Provide recessed joint configuration of recess depth and at locations indicated on Drawings according to Figure 8C in ASTM C1193.

    a. Use masking tape to protect surfaces adjacent to recessed tooled joints.

3.4 FIELD QUALITY CONTROL

A. Field-Adhesion Testing: Field test joint-sealant adhesion to joint substrates as follows:

1. Extent of Testing: Test completed and cured sealant joints as follows:

    a. Perform 10 tests for the first 1000 feet of joint length for each kind of sealant and joint substrate.
    b. Perform one test for each 1000 feet of joint length thereafter or one test per each floor per elevation.

2. Test Method: Test joint sealants according to Method A, Field-Applied Sealant Joint Hand Pull Tab, in Appendix X1 in ASTM C1193 or Method A, Tail Procedure, in ASTM C1521.

    a. 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.

3. Inspect tested joints and report on the following:

    a. Whether sealants filled joint cavities and are free of voids.
    b. Whether sealant dimensions and configurations comply with specified requirements.
    c. 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.

4. 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.
5. 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.

B. 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.

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. Joint-Sealant Application: Exterior joints in horizontal traffic surfaces.

1. Joint Locations:

    a. Isolation and contraction joints in cast-in-place concrete slabs.

2. Joint Sealant: Urethane, M, NS, 25, T, NT.
3. Joint-Sealant Color: As selected by Architect from manufacturer's full range of colors.

B. Joint-Sealant Application: Exterior joints in vertical surfaces and horizontal nontraffic surfaces.

1. Joint Locations:

    a. Construction joints in cast-in-place concrete.
    b. Joints between metal panels.
    c. Joints between different materials listed above.
    d. Perimeter joints between materials listed above and frames of doors and windows.

e. Control and expansion joints in overhead surfaces.

2. Joint Sealant: Silicone, nonstaining, S, NS, 50, NT.
3. Joint-Sealant Color: As selected by Architect from manufacturer's full range of colors.

C. Joint-Sealant Application: Interior joints in horizontal traffic surfaces.

1. Joint Locations:

a. Isolation joints in cast-in-place concrete slabs.
b. Control and expansion joints in tile flooring.

2. Joint Sealant: Urethane, S, P, 25, T, NT.
3. Joint-Sealant Color: As selected by Architect from manufacturer's full range of colors.

D. Joint-Sealant Application: Interior joints in vertical surfaces and horizontal nontraffic surfaces.

1. Joint Locations:

a. Control and expansion joints on exposed interior surfaces of exterior walls.
b. Tile control and expansion joints.
c. Vertical joints on exposed surfaces of concrete walls.

2. Joint Sealant: Urethane, S, NS, 25, NT.
3. Joint-Sealant Color: As selected by Architect from manufacturer's full range of colors.

E. Joint-Sealant Application: Interior joints in vertical surfaces and horizontal nontraffic surfaces subject to movement and required to be paintable.

1. Joint Locations:

a. Gypsum board to door and window frames, penetrating conduits and piping, light-fixtures, electrical cover plates, building specialty items, ductwork, grilles, supply diffusers, faucets, piping, escutcheon plates and similar items.
b. Woodwork to abutting surfaces.

2. Joint Sealant: STPE, S, NS, 50, NT.
3. Joint-Sealant Color: As selected by Architect from manufacturer's full range of colors.

F. Joint-Sealant Application: 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 and windows.

2. Joint Sealant: Acrylic latex.
3. Joint-Sealant Color: As selected by Architect from manufacturer's full range of colors.

G. Joint-Sealant Application: Mildew-resistant interior joints in vertical surfaces and horizontal nontraffic surfaces.

1. Joint Locations:

a. Joints between plumbing fixtures and adjoining walls, floors, and counters.
b. Joints where USDA approval is required.
c. Tile control and expansion joints where indicated.

2. Joint Sealant: Silicone, mildew resistant, acid curing, S, NS, 50, NT.
3. Joint-Sealant Color: As selected by Architect from manufacturer's full range of colors.

H. Joint-Sealant Application: Concealed mastics.

1. Joint Locations:

a. Aluminum thresholds.
b. Sill plates.

2. Joint Sealant: Butyl-rubber based.
3. Joint-Sealant Color: As selected by Architect from manufacturer's full range of colors.

END OF SECTION 07 9200

SECTION 07 9219 - ACOUSTICAL JOINT SEALANTS

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes acoustical joint sealants.

B. Related Requirements:

1. Section 07 9200 "Joint Sealants" for elastomeric, latex, and butyl-rubber-based joint sealants for nonacoustical applications.

1.2 ACTION SUBMITTALS

A. Product Data: For each acoustical joint sealant.

B. Samples for Verification: For each kind and color of acoustical 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.

C. 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 kind of acoustical joint sealant, for tests performed by a qualified testing agency.

1.4 QUALITY REQUIREMENTS

A. Where conflicting information is found in the Construction Documents related to products, details or dimensional discrepancies, comply with the most stringent requirements regardless of cost.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Provide acoustical joint-sealant products that effectively reduce airborne sound transmission through perimeter joints and openings in building construction, as demonstrated by testing representative assemblies according to ASTM E90.

1. Sealant shall have a VOC content of 250 g/L or less.

2.2 ACOUSTICAL JOINT SEALANTS

A. Acoustical Sealant for Exposed and Concealed Joints: Manufacturer's standard nonsag, paintable, nonstaining latex acoustical sealant complying with ASTM C834.

1. Products: Subject to compliance with requirements, provide one of the following:

   a. GE Construction Sealants; Momentive Performance Materials Inc.; RCS20 Acoustical.
   b. Hilti, Inc.; CP 506 Smoke and Acoustical Sealant.
   c. OSI Sealants; Henkel Corporation; OSI Pro-Series SC-175 Acoustical Sound Sealant.
   d. Pecora Corporation; AC-20 FTR.
   e. USG Corporation; SHEETROCK Acoustical Sealant.

2. Colors of Exposed Acoustical Joint Sealants: As selected by Architect from manufacturer's full range of colors.

2.3 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 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 unless more stringent requirements apply.

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 recommendations 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 manufacturers 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 9219

SECTION 08 1113 - HOLLOW METAL DOORS AND FRAMES

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Interior standard steel doors and frames.
2. Exterior standard steel doors and frames.

B. Related Requirements:

1. Section 08 7100 "Door Hardware" for door hardware for hollow-metal doors.

1.2 DEFINITIONS

A. Minimum Thickness: Minimum thickness of base metal without coatings in accordance with NAAMM-HMMA 803 or ANSI/SDI A250.8.

1.3 COORDINATION

A. Coordinate anchorage installation for hollow-metal frames. Furnish setting drawings, templates, and directions for installing anchorages, including sleeves, concrete inserts, anchor bolts, and items with integral anchors. Deliver such items to Project site in time for installation.

B. Coordinate requirements for installation of door hardware, electrified door hardware, and access control and security systems.

1.4 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1.5 ACTION SUBMITTALS

A. Product Data:

1. Interior standard steel doors and frames.
2. Exterior standard steel doors and frames.

B. Product Data Submittals: For each product.

1. Include construction details, material descriptions, core descriptions, and finishes.

C. Shop Drawings: Include the following:

1. Elevations of each door type.
2. Details of doors, including vertical- and horizontal-edge details and metal thicknesses.
3. Frame details for each frame type, including dimensioned profiles and metal thicknesses.
4. Locations of reinforcement and preparations for hardware.
5. Details of each different wall opening condition.
6. Details of electrical raceway and preparation for electrified hardware, access control systems, and security systems.
7. Details of anchorages, joints, field splices, and connections.
8. Details of accessories.
9. Details of moldings, removable stops, and glazing.

D. Samples for Verification:

1. Fabrication: Prepare Samples approximately 8 by 10 inches to demonstrate compliance with requirements for quality of materials and construction:

a. Doors: Show vertical-edge, top, and bottom construction; core construction; and hinge and other applied hardware reinforcement. Include separate section showing glazing if applicable.
b. Frames: Show profile, corner joint, floor and wall anchors, and silencers. Include separate section showing fixed hollow-metal panels and glazing if applicable.

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 as those on Drawings. Coordinate with final door hardware schedule.

1.6 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.

1. Provide additional protection to prevent damage to factory-finished units.

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.

PART 2 - PRODUCTS

2.1 HOLLOW METAL DOORS AND FRAMES

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Ceco Door; AADG, Inc.; ASSA ABLOY.
2. Curries, AADG, Inc.; ASSA ABLOY Group.
3. Custom Metal Products.
4. DCI Hollow Metal on Demand.
5. Deansteel Manufacturing Company, Inc.
6. Fleming Door Products Ltd.; ASSA ABLOY Group.
7. MPI Group, LLC (The).
8. MegaMet Industries.
9. Mesker Door; Mesker Openings Group.
10. North American Door Corp.
11. Philipp Manufacturing Co (The).
12. Pioneer Industries; AADG, Inc.; ASSA ABLOY.
13. Premier Products, Inc.
14. Republic Doors and Frames; a Allegion brand.
15. Rocky Mountain Metals, Inc.
16. Steelcraft; Allegion plc.

2.2 PERFORMANCE REQUIREMENTS

A. Thermally Rated Door Assemblies: Provide door assemblies with U-factor of not more than 0.40 deg Btu/F x h x sq. ft. when tested in accordance with ASTM C1363 or ASTM E1423.

2.3 INTERIOR STANDARD STEEL DOORS AND FRAMES

A. Construct hollow-metal doors and frames to comply with standards indicated for materials, fabrication, hardware locations, hardware reinforcement, tolerances, and clearances, and as specified.

B. Standard-Duty Doors and Frames: ANSI/SDI A250.8, Level 1; ANSI/SDI A250.4, Level C..

1. Doors:

   a. Thickness: 1-3/4 inches.
   b. Face: Uncoated steel sheet, minimum thickness of 0.032 inch.
   c. Edge Construction: Model 2, Seamless.
   d. Edge Bevel: Provide manufacturer's standard beveled or square edges.
   e. Core: Manufacturer's standard.

2. Frames:

   a. Materials: Uncoated steel sheet, minimum thickness of 0.042 inch.

b. Sidelite and Transom Frames: Fabricated from same thickness material as adjacent door frame.
c. Construction: Full profile welded.

3. Exposed Finish: Prime.

2.4 EXTERIOR STANDARD STEEL DOORS AND FRAMES

A. Construct hollow-metal doors and frames to comply with standards indicated for materials, fabrication, hardware locations, hardware reinforcement, tolerances, and clearances, and as specified.

B. Heavy-Duty Doors and Frames: ANSI/SDI A250.8, Level 2; ANSI/SDI A250.4, Level B..

1. Doors:

a. Thickness: 1-3/4 inches.
b. Face: Metallic-coated steel sheet, minimum thickness of 0.042 inch, with minimum A40 coating.
c. Edge Construction: Model 2, Seamless.
d. Edge Bevel: Provide manufacturer's standard beveled or square edges.
e. Top Edge Closures: Close top edges of doors with flush closures of same material as face sheets. Seal joints against water penetration.
f. Bottom Edges: Close bottom edges of doors with end closures or channels of same material as face sheets. Provide weep-hole openings in bottoms of exterior doors to permit moisture to escape.
g. Core: Polyisocyanurate.

2. Frames:

a. Materials: Metallic-coated steel sheet, minimum thickness of 0.053 inch, with minimum A40 coating.
b. Construction: Full profile welded.

3. Exposed Finish: Prime.

2.5 FRAME ANCHORS

A. Jamb Anchors:

1. Type: Anchors of minimum size and type required by applicable door and frame standard, and suitable for performance level indicated.
2. 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 feet.
3. Postinstalled Expansion Anchor: Minimum 3/8-inch-diameter bolts with expansion shields or inserts, with manufacturer's standard pipe spacer.

B. Floor Anchors: Provide floor anchors for each jamb and mullion that extends to floor.

C. Floor Anchors for Concrete Slabs with Underlayment: Adjustable-type anchors with extension clips, allowing not less than 2-inch height adjustment. Terminate bottom of frames at top of underlayment.

D. Material: ASTM A879/A879M, Commercial Steel (CS), 04Z coating designation; mill phosphatized.

1. For anchors built into exterior walls, steel sheet complying with ASTM A1008/A1008M or ASTM A1011/A1011M; hot-dip galvanized in accordance with ASTM A153/A153M, Class B.

2.6 MATERIALS

A. Cold-Rolled Steel Sheet: ASTM A1008/A1008M, Commercial Steel (CS), Type B; suitable for exposed applications.

B. Metallic-Coated Steel Sheet: ASTM A653/A653M, Commercial Steel (CS), Type B.

C. Inserts, Bolts, and Fasteners: Hot-dip galvanized in accordance with ASTM A153/A153M.

D. 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.

E. 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.

F. Glazing: Comply with requirements in Section 08 8000 "Glazing."

2.7 FABRICATION

A. Hollow-Metal 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 of metal of same or greater thickness as frames.

1. Sidelite 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 jambs by welding, or by rigid mechanical anchors.
2. Provide countersunk, flat- or oval-head exposed screws and bolts for exposed fasteners unless otherwise indicated.
3. Door Silencers: Except on weather-stripped frames, drill stops to receive door silencers as follows. Keep holes clear during construction.

a. Single-Door Frames: Drill stop in strike jamb to receive three door silencers.

B. 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 Schedule on Drawings, and templates.

1. Reinforce doors and frames to receive nontemplated, mortised, and surface-mounted door hardware.
2. Comply with BHMA A156.115 for preparing hollow-metal doors and frames for hardware.

C. Glazed Lites: Provide stops and moldings around glazed lites where indicated. Form corners of stops and moldings with butted or mitered hairline joints.

1. Provide fixed frame moldings on outside of exterior and on secure side of interior doors and frames. Provide loose stops and moldings on inside of hollow-metal doors and frames.
2. Coordinate rabbet width between fixed and removable stops with glazing and installation types indicated.
3. Provide stops for installation with countersunk flat- or oval-head machine screws spaced uniformly not more than 9 inches o.c. and not more than 2 inches o.c. 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 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.

3.2 INSTALLATION

A. 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.

B. Hollow-Metal Frames: Comply with ANSI/SDI A250.11.

1. Set frames accurately in position; plumbed, aligned, and braced securely until permanent anchors are set. After wall construction is complete, remove temporary braces without damage to completed Work.

    a. Where frames are fabricated in sections, field splice at approved locations by welding face joint continuously; grind, fill, dress, and make splice smooth, flush, and invisible on exposed faces. Touch-up finishes.
    b. Install frames with removable stops located on secure side of opening.

2. Floor Anchors: Secure with postinstalled expansion anchors.

    a. Floor anchors may be set with power-actuated fasteners instead of postinstalled expansion anchors if so indicated and approved on Shop Drawings.

3. Solidly pack mineral-fiber insulation inside frames.
4. In-Place Concrete or Masonry Construction: Secure frames in place with postinstalled expansion anchors. Countersink anchors, and fill and make smooth, flush, and invisible on exposed faces.
5. Installation Tolerances: Adjust hollow-metal frames to the following tolerances:

    a. Squareness: Plus or minus 1/16 inch, measured at door rabbet on a line 90 degrees from jamb perpendicular to frame head.
    b. Alignment: Plus or minus 1/16 inch, measured at jambs on a horizontal line parallel to plane of wall.
    c. Twist: Plus or minus 1/16 inch, measured at opposite face corners of jambs on parallel lines, and perpendicular to plane of wall.
    d. Plumbness: Plus or minus 1/16 inch, measured at jambs at floor.

C. Hollow-Metal Doors: Fit and adjust hollow-metal doors accurately in frames, within clearances specified below.

    1. Non-Fire-Rated Steel Doors: Comply with ANSI/SDI A250.8.

D. Glazing: Comply with installation requirements in Section 08 8000 "Glazing" and with hollow-metal manufacturer's written instructions.

3.3 REPAIR

A. 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.

B. Metallic-Coated Surface Touchup: Clean abraded areas and repair with galvanizing repair paint in accordance with manufacturer's written instructions.

END OF SECTION 08 1113

SECTION 08 1116 - INTERIOR ALUMINUM DOORS AND FRAMES

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Interior aluminum storefront frames.
2. Interior aluminum framed sliding (barn) doors.

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.

    a. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes.

B. Shop Drawings:

1. Elevations, sections, and installation details for each wall-opening condition.
2. Details of construction of each component, including dimensioned profiles and metal thicknesses.
3. Locations of reinforcements and preparations for hardware.
4. Details of anchorages, joints, splices, connections, and accessories.
5. Details of trim, removable stops, and glazing.

C. Samples for Verification: Actual sample of finished products for each type of the following products:

1. Framing Member and Finish: 12 inches long. Include trim.
2. Window Corner Fabrication and Finish: 12-by-12-inch-long, full-size corner, including full-size sections of extrusions with removable stops.
3. Door Finish: Manufacturer's standard-size unit, but not less than 3 inches square.

D. Product Schedule: Use same designations indicated on Drawings. Coordinate with door hardware schedule and glazing.

1.4 CLOSEOUT SUBMITTALS

A. Maintenance Data: For interior aluminum doors and frames.

1.5 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 sliding door and frame.
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.

PART 2 - PRODUCTS

2.1 INTERIOR ALUMINUM 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. Avalon International Aluminum LLC.
2. Frameworks.
3. RACO Interiors.
4. Special-Lite.
5. Tubelite Inc.
6. Wilson Partitions; a division of Arcadia Inc.

B. Source Limitations: Obtain interior aluminum doors and frames from single source from single manufacturer.

C. Aluminum Framing: ASTM B221, with alloy and temper required to suit structural and finish requirements, and not less than 0.062 inch thick.

D. Door Frames: Extruded aluminum, reinforced for hinges, strikes, and closers.

E. Glazing Frames: Extruded aluminum, for glass thickness indicated in schedules.

F. Sliding-Door Head Tracks: Extruded aluminum where exposed; provide complete with door-hanging roller assemblies and floor guides. See Section 08 7100 "Door Hardware."

G. Trim: Extruded aluminum, not less than 0.062 inch thick; removable, snap-in glazing stops, without exposed fasteners.

1. Trim Style: As indicated on Drawings.

H. Aluminum-Framed Sliding Glass Doors: Manufacturer's standard, factory-assembled, 1-3/4-inch-thick doors.

1. Stile Width: Narrow.
2. Top-Rail Height: 3-3/4 inches.
3. Bottom-Rail Height: 6 inches.

2.2 ACCESSORIES

A. Fasteners: Aluminum, nonmagnetic, stainless steel, zinc-plated steel or other noncorrosive metal fasteners compatible with frames, stops, panels, reinforcement plates, hardware, anchors, and other items being fastened.

B. Corner Reinforcements and Alignment Clips: Manufacturer's standard concealed units to provide accurately fitted hairline joints at butted and mitered connections.

C. Glazing Gaskets: Manufacturer's standard extruded or molded rubber or plastic, to accommodate glazing thickness indicated; black.

D. Glazing Stops: Removable to allow glazing replacement without framing disassembly.

E. Glass: As specified in Section 08 8000 "Glazing."

F. Door Hardware: As specified in Section 08 7100 "Door Hardware."

2.3 FABRICATION

A. Hardware Preparation: Factory prepare components to receive templated mortised hardware; include cutouts, reinforcements, mortising, drilling, and tapping.

1. Reinforce doors and frames to receive nontemplated mortised and surface-mounted hardware.
2. Locate hardware as indicated on Drawings.

B. Glazing Stops: Locate removable stops on inside of spaces accessed by locking doors.

C. Fabricate components to allow secure installation without exposed fasteners and to provide accurately fitted hairline joints at butted and mitered connections.

D. Fabricate frame components 96 inches long or shorter as one piece. Where splices are required, no individual piece may be less than 48 inches long.

E. Fabricate door assemblies for sliding operation to conceal door-hanging roller assemblies from view.

2.4 ALUMINUM 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. Color Anodic Finish: AAMA 611, AA-M12C22A42/A44, Class I, 0.018 mm or thicker.

1. Color: Black.

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

3.2 INSTALLATION OF ALUMINUM DOORS AND FRAMES

A. Install aluminum frames plumb, rigid, properly aligned, and securely fastened in place in accordance with manufacturer's written instructions.

1. Use concealed installation clips to produce tightly fitted and aligned splices and connections.
2. Secure clips to extruded main-frame components and not to snap-in or trim members.
3. Do not leave screws or other fasteners exposed to view when installation is complete.

B. Glass: Install glass in accordance with Section 08 8000 "Glazing" and aluminum-frame manufacturer's written instructions.

C. Doors: Install doors aligned with frames and fitted with required hardware.

1. Hardware: Install in accordance with Section 08 7100 "Door Hardware" and aluminum-frame manufacturer's written instructions.

3.3 ADJUSTING AND CLEANING

A. Inspect installation, correct misalignments, and tighten loose connections.

B. Doors: Adjust doors to operate smoothly and easily, without binding or warping. Adjust hardware to function smoothly in accordance with manufacturer's written instructions.

C. Clean exposed frame surfaces promptly after installation, using cleaning methods recommended in writing by frame manufacturer and in accordance with AAMA 609 & 610.

D. Touch Up: Immediately after installation, repair damaged areas of aluminum finishes and touchup in accordance with manufacturer's written instructions.

END OF SECTION 08 1116

SECTION 08 1416 - FLUSH WOOD DOORS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Five-ply flush wood veneer-faced doors for transparent finish.
2. Factory finishing flush wood doors.
3. Factory fitting flush wood doors to frames and factory machining for hardware.

B. Related Requirements:

1. Section 08 8000 "Glazing" for glass view panels in flush wood doors.

1.2 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of door indicated. Include details of core and edge construction and trim for openings. Include 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 location, type, size, and swing.
2. Door elevations, dimension and locations of hardware, lite 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 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 Samples showing typical range of color and grain to be expected in finished Work.

2. Frames for light openings, 6 inches long, for each material, type, and finish required.

1.4 INFORMATIONAL SUBMITTALS

A. Sample Warranty: For special warranty.

1.5 CLOSEOUT SUBMITTALS

A. Special warranties.

1.6 QUALITY ASSURANCE

A. Source Limitations: Obtain flush wood doors from single manufacturer.

B. Quality Standard: In addition to requirements specified, comply with AWI's "Architectural Woodwork Quality Standards Illustrated."

C. Preinstallation Conference: Conduct conference at Project site.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Comply with requirements of referenced standard and manufacturer's written instructions.

B. Package doors individually in plastic bags or cardboard cartons.

C. Mark each door on top and bottom rail with opening number used on Shop Drawings.

1.8 PROJECT CONDITIONS

A. Environmental Limitations: Do not deliver or install doors until spaces are enclosed and weathertight, wet work in spaces is complete and dry, and HVAC system is operating and maintaining ambient temperature and humidity conditions at occupancy levels during the remainder of the construction period.

1.9 WARRANTY

A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace doors 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 shall also include installation and finishing that may be required due to repair or replacement of defective doors.
3. Warranty Period for Solid-Core Interior Doors: Life of installation.

PART 2 - PRODUCTS

2.1 FLUSH WOOD DOORS, GENERAL

A. Quality Standard: In addition to requirements specified, comply with ANSI/WDMA I.S. 1A.

1. 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.

2.2 SOLID-CORE FIVE-PLY FLUSH WOOD VENEER-FACED DOORS FOR TRANSPARENT FINISH

A. Interior Doors:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

    a. Masonite Architectural.
    b. Oshkosh Door Company.
    c. VT Industries, Inc.

2. Performance Grade:

    a. ANSI/WDMA I.S. 1A Heavy Duty unless otherwise indicated on Drawings.
    b. ANSI/WDMA I.S. 1A Extra Heavy Duty: Classrooms, public toilets, janitor's closets, assembly spaces, and exits.
    c. ANSI/WDMA I.S. 1A Standard Duty: Closets (not including janitor's closets).

3. ANSI/WDMA I.S. 1A Grade: Custom.
4. Faces: Single-ply wood veneer not less than 1/50 inch thick.

    a. Species: White oak.
    b. Cut: Plain sliced (flat sliced).
    c. Match between Veneer Leaves: Book match.
    d. Assembly of Veneer Leaves on Door Faces: Center-balance match.
    e. Room Match: 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 feet or more.
    f. Exposed Vertical and Top Edges: Same species as faces.
    g. Core for Non-Fire-Rated Doors:

        1) ANSI A208.1, Grade LD-1 particleboard.

2) Blocking: Provide wood blocking in particleboard-core doors as needed to eliminate through-bolting hardware.
3) Provide doors with glued-wood-stave cores instead of particleboard cores for doors scheduled to receive exit devices in Section 08 7100 "Door Hardware."

5. Construction: Five plies, hot-pressed bonded (vertical and horizontal edging is bonded to core), with entire unit abrasive planed before veneering.

2.3 LIGHT FRAMES

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: Match existing.

2.4 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.

B. Factory machine doors for hardware that is not surface applied.

1. Locate hardware to comply with DHI-WDHS-3.
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.

C. 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 08 8000 "Glazing."

2.5 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. Finish doors at factory.

C. Transparent Finish:

1. Grade: Custom.
2. Finish: Architectural Woodwork Standards System-11, Polyurethane, Catalyzed.
3. Staining: As required to match Architect’s Sample.
4. Effect: Open-grain finish.
5. Sheen: Satin.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine doors and installed door frames before hanging doors.

1. Verify that frames comply with indicated requirements for type, size, location, and swing characteristics and have been installed with level heads and plumb jambs.
2. Reject doors with defects.

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

3.2 INSTALLATION

A. Hardware: For installation, see Section 08 7100 "Door Hardware."

B. Install doors 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.

D. Factory-Fitted Doors: Align in frames for uniform clearance at each edge.

E. Factory-Finished Doors: Restore finish before installation if fitting or machining is required at Project site.

3.3 ADJUSTING

A. Operation: Rehang or replace doors that do not swing or operate freely.

B. 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 1416

SECTION 08 3113 - ACCESS DOORS AND FRAMES

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes access doors and frames for walls and ceilings.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Include construction details material descriptions, dimensions of individual components and profiles, and finishes.

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.

PART 2 - PRODUCTS

2.1 ACCESS DOORS AND FRAMES

A. Flush Access Doors with Exposed Flanges:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Acudor Products, Inc.
b. Babcock-Davis.
c. JL Industries, Inc.; a division of the Activar Construction Products Group.
d. Larsens Manufacturing Company.
e. Maxam Metal Products Limited.
f. MIFAB, Inc.
g. Milcor; Commercial Products Group of Hart & Cooley, Inc.
h. Nystrom.
i. Williams Bros. Corporation of America (The).

2. Description: Face of door flush with frame, with exposed flange and concealed hinge.
3. Locations: Walls and ceilings.
4. Door Size: As indicated.
5. Uncoated Steel Sheet for Door: Nominal 0.060-inch, 16 gage, factory primed.
6. Frame Material: Same material, thickness, and finish as door.

7. Latch and Lock: Cam latch, screwdriver operated.

2.2 MATERIALS

A. Steel Plates, Shapes, and Bars: ASTM A36/A36M.

B. Steel Sheet: Uncoated or electrolytic zinc coated, ASTM A879/A879M, with cold-rolled steel sheet substrate complying with ASTM A1008/A1008M, Commercial Steel (CS), exposed.

C. Frame Anchors: Same material as door face.

D. Inserts, Bolts, and Anchor Fasteners: Hot-dip galvanized steel according to ASTM A153/A153M or ASTM F2329.

2.3 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.

D. 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.

2.4 FINISHES

A. Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.

B. Protect mechanical finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.

C. 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.

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.

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

A. Comply with manufacturer's written instructions for installing access doors and frames.

3.3 ADJUSTING

A. Adjust doors and hardware, after installation, for proper operation.

END OF SECTION 08 3113

SECTION 08 4113 - ALUMINUM-FRAMED ENTRANCES AND STOREFRONTS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Aluminum-framed exterior storefront systems.
2. Aluminum-framed interior vestibule storefront systems.
3. Aluminum framed punched windows.
4. Aluminum-framed entrance systems.

B. Related Requirements:

1. Section 08 1116 "Interior Aluminum Doors and Frames" for interior aluminum framing other than at Vestibules, and at framed aluminum sliding (barn) doors.

1.2 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1.3 ACTION SUBMITTALS

A. Product Data:

1. Aluminum-framed entrance and storefront systems.

B. Product Data Submittals: For each product.

1. Construction details, material descriptions, dimensions of individual components and profiles, and finishes.
2. Operating characteristics, electrical characteristics, and furnished accessories.

C. Shop Drawings:

1. Plans, elevations, sections, full-size details, and attachments to other work.
2. Details of provisions for assembly expansion and contraction and for draining moisture occurring within the assembly to the exterior.
3. 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. Connection to and continuity with adjacent thermal, weather, air, and vapor barriers.
5. 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.

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 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 entrances 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 exterior 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 aluminum-framed entrance and storefront systems.

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. Delegated Design Engineer Qualifications: For aluminum-framed entrance and storefront systems.

H. Sample Warranties: For aluminum-framed entrance and storefront systems.

1.5 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For aluminum-framed entrance and storefront systems.

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 and who are certified under the Architectural Glass and Metal Technician (AGMT) certification program.

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.

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 approval. If changes are proposed, submit comprehensive explanatory data to Architect for review.

1.7 MOCKUPS

A. Build mockups to set quality standards for materials and execution and to set quality standards for fabrication and installation.

1. Build mockup where directed by Architect.
2. Testing to 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 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 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, 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: Five years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 SOURCE LIMITATIONS

A. Obtain all components of aluminum-framed entrance and storefront system, including framing and accessories, from single manufacturer.

2.2 PERFORMANCE REQUIREMENTS

A. Delegated Design: Engage a qualified professional engineer, as defined in Section 01 4000 "Quality Requirements," to design aluminum-framed entrance and storefront systems.

B. General Performance: Comply with performance requirements specified, for exterior framing 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. 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 clear span for spans of up to 13 feet 6 inches and to 1/240 of clear span plus 1/4 inch for spans greater than 13 feet 6 inches.
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.

E. 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.

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, 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 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.

H. 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.

I. 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 0.38 Btu/sq. ft. x h x deg F as determined in accordance with NFRC 100.
b. Entrance Doors: U-factor of not more than 0.77 Btu/sq. ft. x h x deg F 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 0.38 as determined in accordance with NFRC 200.
b. Entrance Doors: SHGC of not more than 0.40 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.
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.

4. Condensation Resistance Factor (CRF):

a. Fixed Glazing and Framing Areas: CRF for the system of not less than 70 as determined in accordance with AAMA 1503.
b. Entrance Doors: CRF of not less than 57 as determined in accordance with AAMA 1503.

J. 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.
c. Interior Ambient-Air Temperature: 75 deg F.

2.3 ALUMINUM-FRAMED ENTRANCE AND STOREFRONT SYSTEMS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. EFCO Corporation.
2. Kawneer Company, Inc.; Arconic Corporation.
3. Manko Window Systems, Inc.
4. OldCastle BuildingEnvelope (OBE).
5. Pittco Architectural Metals, Inc.
6. U.S. Aluminum; C.R. Laurence Co., Inc.; CRH Americas, Inc.
7. YKK AP America Inc.

B. Framing Members: Manufacturer's extruded- or formed-aluminum framing members of thickness required and reinforced as required to support imposed loads.

1. Exterior Framing Construction: Thermally broken.
2. Interior Vestibule Framing Construction: Nonthermal.
3. Typical Glazing System: Retained mechanically with gaskets on four sides.
4. Glazing System at Interior Framing Where Butt glazing is Shown: Retained mechanically with gaskets at perimeter and structural sealant at butt glazing.
5. Glazing Plane: Center, unless indicated otherwise.
6. Finish: Color anodic finish.

7. Fabrication Method: Field-fabricated stick system.
8. Aluminum: Alloy and temper recommended by manufacturer for type of use and finish indicated.
9. Steel Reinforcement: As required by manufacturer.

C. Backer Plates: Manufacturer's standard, continuous backer plates for framing members, if not integral, where framing abuts adjacent construction.

D. Brackets and Reinforcements: Manufacturer's standard high-strength aluminum with nonstaining, nonferrous shims for aligning system components.

E. Entrance Doors: Manufacturer's standard glazed entrance doors for manual-swing or automatic operation.

1. 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.

a. Thermal Construction: High-performance plastic connectors separate aluminum members exposed to the exterior from members exposed to the interior.

2. Door Design: Narrow stile; 2-1/8-inch nominal width.
3. Glazing Stops and Gaskets: Beveled, snap-on, extruded-aluminum stops and preformed gaskets.

a. Provide nonremovable glazing stops on outside of door.

4. Finish: Match adjacent storefront framing finish.

2.4 ENTRANCE DOOR HARDWARE

A. Entrance Door Hardware: Hardware not specified in this Section is specified in Section 08 7100 "Door Hardware."

2.5 GLAZING

A. Glazing: Comply with Section 08 8000 "Glazing."

B. Glazing Gaskets: Manufacturer's standard sealed-corner pressure-glazing system of black, resilient elastomeric glazing gaskets, setting blocks, and shims or spacers.

C. Glazing Sealants: As recommended by manufacturer.

2.6 MATERIALS

A. Sheet and Plate: ASTM B209.

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.

2.7 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. Do not provide system that requires exposed fasteners.

B. Anchors: Three-way adjustable anchors with minimum adjustment of 1 inch 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: Dead-soft, 0.018-inch-thick stainless steel, complying with ASTM A240/A240M, of type recommended by manufacturer.

D. Bituminous Paint: Cold-applied asphalt-mastic paint containing no asbestos, formulated for 30-mil thickness per coat.

E. Rigid PVC filler.

2.8 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. Entrance Door Frames: Reinforce as required to support loads imposed by door operation and for installing entrance door hardware.

1. At exterior doors, provide compression weather stripping at fixed stops.

F. Entrance Doors: Reinforce doors as required for installing entrance door hardware.

1. At pairs of exterior doors, provide sliding-type weather stripping retained in adjustable strip and mortised into door edge.
2. At exterior doors, provide weather sweeps applied to door bottoms.

G. Entrance Door Hardware Installation: Factory install entrance door hardware to the greatest extent possible. Cut, drill, and tap for factory-installed entrance door hardware before applying finishes.

H. After fabrication, clearly mark components to identify their locations in Project in accordance with Shop Drawings.

2.9 ALUMINUM FINISHES

A. Color Anodic Finish: AAMA 611, AA-M12C22A42/A44, Class I, 0.018 mm or thicker.

1. Color: Black.

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. 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. Seal perimeter and other joints watertight unless otherwise indicated.

G. 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 by installing nonconductive spacers.
2. Where aluminum is in contact with concrete or masonry, protect against corrosion by painting contact surfaces with bituminous paint.

H. Set continuous sill members and flashing in full sealant bed, as specified in Section 07 9200 "Joint Sealants," to produce weathertight installation.

I. Install joint filler behind sealant as recommended by sealant manufacturer.

J. Install components plumb and true in alignment with established lines and grades.

K. Install operable units level and plumb, securely anchored, and without distortion. Adjust weather-stripping contact and hardware movement to produce proper operation.

L. 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.

M. Install glazing as specified in Section 08 8000 "Glazing."

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 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.

3.4 FIELD QUALITY CONTROL

A. Testing Agency: 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.

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 and cyclic 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.

C. Aluminum-framed entrance and storefront systems will be considered defective if they do not pass tests and inspections.

D. Prepare test and inspection reports.

3.5 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 the same as those used in the manufacture and installation of original equipment.

END OF SECTION 08 4113

SECTION 08 4126 - ALL-GLASS ENTRANCES AND STOREFRONTS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Interior sliding all-glass entrance doors.
2. Interior all-glass storefronts.

B. Related Requirements:

1. Section 05 5000 "Metal Fabrications" for overhead-steel support for all-glass systems.

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. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for all-glass system.

B. Shop Drawings: For all-glass entrances and storefronts.

1. Include plans, elevations, and sections.
2. Include details of fittings and glazing, including isometric drawings of and rail fittings.
3. Door hardware locations, mounting heights, and installation requirements.

C. Samples for Verification: For each type of exposed finish indicated, prepared on Samples of size indicated below.

1. Metal Finishes: 6-inch-long sections of rail fittings, accessory fittings, and other items.
2. Glass: 6 inches square, showing exposed-edge finish.
3. Door Hardware: For exposed door hardware of each type, in specified finish, full size.

D. Fabrication Sample: Continuous rail fitting at bottom, made from 12-inch lengths of full-size components and showing details of the following:

1. Joinery.
2. Anchorage.
3. Glazing with butt glazing.

E. Entrance Door Hardware Schedule: Prepared by or under supervision of supplier, detailing fabrication and assembly of entrance door hardware, as well as procedures and diagrams. Coordinate final entrance door hardware schedule with doors and related work to ensure proper size, thickness, hand, function, and finish of entrance door hardware.

F. Delegated-Design Submittal: For all-glass systems indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

1.4 INFORMATIONAL SUBMITTALS

A. Qualification Data: For Installer.

B. Product Test Reports: For all-glass systems, for tests performed by a qualified testing agency.

C. Sample Warranty: For special warranty.

1.5 CLOSEOUT SUBMITTALS

A. Maintenance Data: For all-glass systems to include in maintenance manuals.

1.6 QUALITY ASSURANCE

A. Installer Qualifications: Manufacturer's authorized representative who is trained and approved for installation of units required for this Project.

B. Product Options: Information on Drawings and in Specifications establishes requirements for aesthetic effects and performance characteristics of assemblies. Aesthetic effects are indicated by dimensions, arrangements, alignment, and profiles of components and assemblies as they relate to sightlines, to one another, and to adjoining construction.

1. Do not change intended aesthetic effects, as judged solely by Architect, except with Architect's approval. If changes are proposed, submit comprehensive explanatory data to Architect for review.

1.7 MOCKUPS

A. Mockups: 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 all-glass system as directed by Architect.
2. Testing shall be performed on mockups according to requirements in "Field Quality Control" Article.
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.

1.8 WARRANTY

A. Special Warranty: Manufacturer agrees to repair or replace components of all-glass systems 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 excessive deflection, air infiltration, or water leakage.
b. Deterioration of metals, metal finishes, and other materials beyond normal weathering.
c. Failure of operating components.

2. Warranty Period: Two 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 01 4000 "Quality Requirements," to design all-glass entrances and storefronts.

B. General Performance: Comply with performance requirements specified, as determined by testing of all-glass entrances and storefronts representing those indicated for this Project without failure due to defective manufacture, fabrication, installation, or other defects in construction.

C. Seismic Performance: All-glass entrances and storefronts shall withstand the effects of earthquake motions determined according to ASCE/SEI 7.

2.2 MANUFACTURERS

A. Products: Subject to compliance with requirements, provide one of the following:

1. Avanti Systems USA; with Solare Sliding Door.
2. Equal approved by Architect before bidding.

2.3 METAL COMPONENTS

A. Fitting Configuration:

1. Manual-Sliding Barn Door, All-Glass Entrance Doors: Continuous rail fitting at top and bottom.

2. All-Glass Storefronts: Continuous rail fitting at top and bottom.

B. Rail Fittings:

1. Material: Aluminum.
2. Height:

a. Top Rail: 3-1/2 inches.
b. Bottom Rail: 3-1/2 inches.

3. Profile: Square.
4. End Caps: Manufacturer's standard precision-fit end caps for rail fittings.

C. Accessory Fittings: Match rail-fitting metal and finish for the following:

1. Center-housing lock.

D. Anchors and Fastenings: Concealed.

E. Materials:

1. Aluminum: ASTM B221, with strength and durability characteristics of not less than Alloy 6063-T5.

a. Color: Black.

2.4 GLASS

A. Glass: ASTM C1048, Kind FT (fully tempered), Condition A (uncoated surfaces), Type I (transparent), tested for surface and edge compression per ASTM C1048 and for impact strength per 16 CFR 1201 for Category II materials.

1. Class 1: Clear monolithic.

a. Thickness: 1/2 inch.
b. Locations: As indicated.

2. Exposed Edges: Machine ground and flat polished.
3. Butt Edges: Flat ground.
4. Corner Edges: Lap-joint corners with exposed edges polished.

2.5 ENTRANCE DOOR HARDWARE

A. General: Heavy-duty entrance door hardware units in sizes, quantities, and types recommended by manufacturer for all-glass entrance systems indicated. For exposed parts, match metal and finish of rail fittings.

B. Push-Pull Set: As selected from manufacturer's full range.

C. Single-Door Locksets: Center-housing deadbolt with pulls.

1. Deadbolt operated by key outside and thumb turn inside.

D. Cylinders: As specified in Section 08 7100 "Door Hardware."

E. Manual-Sliding Entrance Door Hardware: Manufacturer's standard for sliding action indicated and with twin rollers.

1. Type: Wall mounted track.

2.6 BUTT-GLAZING SEALANTS

A. Single-Component, Nonsag, Acid-Curing Silicone Joint Sealant: ASTM C920, Type S, Grade NS, Class 25, for Uses NT, G, and A.

1. Products: Subject to compliance with requirements, provide one of the following:

a. GE Construction Sealants; Momentive Performance Materials Inc.; SCS1000 Contractors.
b. The Dow Chemical Company; DOW CORNING® 999A SILICONE GLAZING SEALANT.

2. Sealant shall have a VOC content of 250 g/L or less.

2.7 FABRICATION

A. Provide holes and cutouts in glass to receive hardware, fittings, and accessory fittings before tempering glass. Do not cut, drill, or make other alterations to glass after tempering.

1. Fully temper glass using horizontal (roller-hearth) process, and fabricate so that when glass is installed, roll-wave distortion is parallel with bottom edge of door or lite.

B. Factory assemble components and factory install hardware and fittings to greatest extent possible.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.

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

3.2 INSTALLATION

A. Install all-glass systems and associated components according to manufacturer's written instructions.

B. Set units level, plumb, and true to line, with uniform joints.

C. Maintain uniform clearances between adjacent components.

D. Lubricate hardware and other moving parts according to manufacturer's written instructions.

E. Set, seal, and grout floor closer cases as required to suit hardware and substrate indicated.

F. Install butt-joint sealants according to manufacturer's instructions and as specified in Section 07 9200 "Joint Sealants" to produce weathertight installation.

3.3 ADJUSTING AND CLEANING

A. Adjust all-glass entrance doors and hardware to produce smooth operation and tight fit at contact points and weather stripping.

B. Remove excess sealant and glazing compounds and dirt from surfaces.

END OF SECTION 08 4126

SECTION 08 7100 - DOOR HARDWARE

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes the following:

1. Commercial door hardware for the following:

   a. Swinging doors.
   b. Other doors to the extent indicated.

2. Cylinders for doors specified in other Sections.
3. Electrified door hardware.

B. Related Sections include the following:

1. Section 08 1213 "Hollow Metal Frames"
2. Section 08 4113 "Aluminum-Framed Entrances and Storefronts"
3. Section 08 1416 "Flush Wood Doors"
4. Division 26 Sections for connections to electrical power system and for low-voltage wiring work.
5. Division 28 Section "Access Control" for access control devices installed at door openings and provided as part of a security access system.
6. Division 28 Section "Intrusion Detection" for detection devices installed at door openings and provided as part of an intrusion detection system.

1.2 ACTION SUBMITTALS

A. Product Data: Include:

1. Manufacturer’s cutsheets.
2. Construction and installation details for each piece of hardware.
3. Material descriptions.
4. Dimensions of individual components and profiles.
5. Locations of hardware reinforcing.
6. Finishes.

B. Shop Drawings: Details of electrified door hardware, indicating the following:

1. Wiring Diagrams: Power, signal, and control wiring. Include the following:

   a. System schematic.
   b. Point-to-point wiring diagram.
   c. Riser diagram.

d. Elevation of each door.

2. Detail interface between electrified door hardware and fire alarm, access control, security, building control system.
3. Operation Narrative: Describe the operation of doors controlled by electrified door hardware.

C. Samples for Verification: For exposed door hardware of each type, in specified finish, full size. Tag with full description for coordination with the door hardware sets. Submit Samples before, or concurrent with, submission of the final door hardware sets, if requested.

1. Samples will be returned to Contractor. Units that are acceptable and remain undamaged through submittal, review, and field comparison process may, after final check of operation, be incorporated into the Work, within limitations of keying requirements.

D. Door Hardware Sets: Prepared by or under the supervision of Architectural Hardware Consultant, detailing fabrication and assembly of door hardware, as well as procedures and diagrams. Coordinate the final door hardware sets with doors, frames, and related work to ensure proper size, thickness, hand, function, and finish of door hardware.

1. Format: Use same scheduling sequence and format and use same door numbers as in the Contract Documents.
2. Content: Include the following information:

a. Identification number, location, hand, fire rating, and material of each door and frame.
b. Type, style, function, size, quantity, and finish of each door hardware item.
c. Complete designations of every item required for each door or opening including name and manufacturer.
d. Fastenings and other pertinent information.
e. Location of each door hardware set, cross-referenced to Drawings, both on floor plans and in door and frame schedule.
f. Explanation of abbreviations, symbols, and codes contained in schedule.
g. Mounting locations for door hardware.
h. Door and frame sizes and materials.
i. Indicate details such as proper type of strike plates, spindle lengths, hand, backset, and bevel of locks, hand and degree opening of closer, length of mop plates, type of door stop, and other necessary information necessary to determine exact hardware requirements.
j. Description of each electrified door hardware function, including location, sequence of operation, and interface with other building control systems.

1) Sequence of Operation: Include description of component functions that occur in the following situations: authorized person wants to enter; authorized person wants to exit; unauthorized person wants to enter; unauthorized person wants to exit.

k. List of related door devices specified in other Sections for each door and frame.

3. Submittal Sequence: Submit the final door hardware sets at earliest possible date, particularly where approval of the door hardware sets must precede fabrication of other work that is critical in Project construction schedule. Include Product Data, Samples, Shop Drawings of other work affected by door hardware, and other information essential to the coordinated review of the door hardware sets.

E. Keying Schedule: Prepared by or under the supervision of Architectural Hardware Consultant, detailing Owner's final keying instructions for locks. Include schematic keying diagram and index each key set to unique door designations.

1.3 INFORMATIONAL SUBMITTALS

A. Qualification Data: For Installer.

B. Product Test Reports: Based on evaluation of comprehensive tests performed by manufacturer and witnessed by a qualified testing agency, for locks, latches, and closers as requested.

1.4 CLOSEOUT SUBMITTALS

A. Maintenance Data: For each type of door hardware to include in maintenance manuals. Include Manufacturer’s installation, adjustment, and maintenance instructions for each piece of hardware. Include Manufacturer’s literature and cut sheets and final hardware and keying schedule and bitting schedule.

B. Warranty: Special warranty specified in this Section.

1.5 QUALITY ASSURANCE

A. Installer Qualifications: An employer of workers trained and approved by lock manufacturer.

1. Installer's responsibilities include supplying and installing door hardware and providing a qualified Architectural Hardware Consultant available during the course of the Work to consult with Contractor, Architect, and Owner about door hardware and keying.
2. Installer shall have warehousing facilities in Project's vicinity.
3. Scheduling Responsibility: Preparation of door hardware and keying schedules.
4. Engineering Responsibility: Preparation of data for electrified door hardware, including Shop Drawings, based on testing and engineering analysis of manufacturer's standard units in assemblies similar to those indicated for this Project.

B. Architectural Hardware Consultant Qualifications: A person who is currently certified by DHI as an Architectural Hardware Consultant and who is experienced in providing consulting services for door hardware installations that are comparable in material, design, and extent to that indicated for this Project.

C. Source Limitations: Obtain each type and variety of door hardware from a single manufacturer, unless otherwise indicated.

1. Provide electrified door hardware from same manufacturer as mechanical door hardware, unless otherwise indicated. Manufacturers that perform electrical modifications and that are listed by a testing and inspecting agency acceptable to authorities having jurisdiction are acceptable.

D. Electrified Door Hardware: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

E. Preinstallation Conference: Conduct conference at Project site.

1. Schedule conference after hardware has been delivered to site and organized into hardware groups by door, but before installation of hardware.
2. Check for appropriate blocking and for correct hardware models and fasteners for substrates.
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. Inspect and discuss preparatory work performed by other trades.
5. Review submittals and set of Manufacturer's installation, adjustment, and maintenance instructions.
6. Inspect and discuss electrical roughing-in for electrified door hardware.
7. Review sequence of operation for each type of electrified door hardware.
8. Review required testing, inspecting, and certifying procedures.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Inventory door hardware on receipt and provide secure lock-up for door hardware delivered to Project site.

B. Neatly and securely package each hardware item separately with identification related to the final door hardware sets for individual door, and include basic installation instructions, templates, and necessary fasteners with each item or package.

1. Include fasteners and accessories necessary for installation and operation of finish hardware in same package.

C. Deliver keys to Owner’s Representative by registered mail or overnight package service.

1. Before Final Acceptance Meeting, send master keys to Facility Manager.

1.7 COORDINATION

A. Templates: Within 14 days after Architect approves hardware schedule, distribute door hardware templates for doors, frames, and other work specified to be factory prepared for installing door hardware. Check Shop Drawings of other work to confirm that adequate provisions are made for locating and installing door hardware to comply with indicated requirements.

B. Coordinate with aluminum entrance door supplier for door hardware installation.

C. Electrical System Roughing-in: Coordinate layout and installation of electrified door hardware with connections to power supplies, fire alarm system and detection devices, access control system, security system, and building control system.

1.8 WARRANTY

A. Manufacturer's standard form in which manufacturer agrees to repair or replace components of door hardware that fail in materials or workmanship within published warranty period.

1. Warranty does not cover damage or faulty operation due to improper installation, improper use or abuse.
2. Warranty Period: Beginning from date of Substantial Completion, for durations indicated in manufacturer's published listings.

a. Mechanical Warranty

1) Locks: 10 years
2) Exit Devices: 3 years
3) Closers: 5 years.

1.9 MAINTENANCE SERVICE

A. 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 door hardware.

B. Maintenance Service: Beginning at Substantial Completion, provide six (6) months' full maintenance by skilled employees of door hardware Installer. Include quarterly preventive maintenance, repair or replacement of worn or defective components, lubrication, cleaning, and adjusting as required for proper door hardware operation. Provide parts and supplies same as those used in the manufacture and installation of original products.

PART 2 - PRODUCTS

2.1 SUPPLIERS

A. Approved Suppliers:

1. Architectural Building Supply, Salt Lake City, UT www.cookandboardman.com:

a. Contact Information: Russ Farley, phone (800) 574-4369, fax 801-484-6817, or e-mail russf@absdoors.com.

2. Beacon Metals Inc, Salt Lake City, UT www.beacon-metals.com:

a. Contact Information: Jared Butler, phone (801) 486-4884, cell (435) 216-2297, FAX 801-485-7647, or e-mail Jared@beacon-metals.com.

3. Midwest D-Vision Solutions, Salt Lake City, UT www.mwdsutah.com:

a. Contact Information: Dan Mercer, office (801) 377-4355, cell (801) 618-9456, e-mail danm@mwdsutah.com.

2.2 MANUFACTURERS

A. Approval of manufacturers and/or products other than those listed as "Scheduled Manufacturer" or "Acceptable Manufacturers" in the individual article for the product category shall be in accordance with QUALITY ASSURANCE article, herein.

B. Approval of products from manufacturers indicated in "Acceptable Manufacturers" is contingent upon those products providing all functions and features and meeting all requirements of scheduled manufacturer's product.

C. Where specified hardware is not adaptable to finished shape or size of members requiring hardware, furnish suitable types having same operation and quality as type specified, subject to Architect's approval.

2.3 MATERIALS

A. Fabrication

1. Provide door hardware manufactured to comply with published templates generally prepared for machine, wood, and sheet metal screws. provide screws according to manufacturer’s recognized installation standards for application intended.
2. Finish exposed screws to match hardware finish, or, if exposed in surfaces of other work, to match finish of this other work including prepared for paint surfaces to receive painted finish.
3. Provide concealed fasteners wherever possible for hardware units exposed when door is closed. Coordinate with “Hollow Metal Frames” and “Flush Wood Doors” to ensure proper reinforcements. Advise the Architect where visible fasteners, such as thru bolts, are required.

a. Provide fasteners of suitable types, sizes and quantities to properly secure hardware. Use fasteners that are of same material and finish as hardware unless otherwise specified. Where fasteners will be exposed to weather, use non-ferrous or corrosion resisting steel.

B. Provide screws, bolts, expansion shields, drop plates and other devices necessary for hardware installation.

1. Where fasteners are exposed to view: Finish to match adjacent door hardware material.

C. Cable and Connectors:

1. Where scheduled in the hardware sets, provide each item of electrified hardware and wire harnesses with number and gage of wires enough to accommodate electric function of specified hardware.
2. Provide Molex connectors that plug directly into connectors from harnesses, electric locking and power transfer devices.
3. Provide through-door wire harness for each electrified locking device installed in a door and wire harness for each electrified hinge, electrified continuous hinge, electrified pivot, and electric power transfer for connection to power supplies.

2.4 HINGES

A. Manufacturers and Products:

1. Interior:

   a. Hager: BB 1279.
   b. Ives: 5BB1.
   c. McKinney: TA 2714.
   d. MacPro / McKinney: MPB79.
   e. PBB: BB81.
   f. Stanley: FBB 179.

2. Exterior:

   a. Hager: BB 1191.
   b. Ives: 5BB1.
   c. McKinney: TA 2314.
   d. PBB: BB21.
   e. Stanley: FBB 191.

A. Requirements:

1. Provide hinges conforming to ANSI/BHMA A156.1.
2. Provide five knuckle, ball bearing hinges.
3. 1-3/4 inch thick doors, up to and including 36 inches wide:

   a. Exterior: Standard weight, solid brass, plated to achieve specified finish, 4 inches high.
   b. Interior: Standard weight, steel, 4 inches high

4. Adjust hinge width for door, frame, and wall conditions to allow proper degree of opening.
5. Provide three hinges per door leaf for doors 90 inches or less in height, and one additional hinge for each 30 inches of additional door height.
6. Hinge Pins: Except as otherwise indicated, provide hinge pins as follows:

   a. Steel Hinges: Steel pins
   b. Non-Ferrous Hinges: Stainless steel pins
   c. Out-Swinging Exterior Doors: Non-removable pins.

d. Interior Non-lockable Doors: Non-rising pins

7. Provide hinges with electrified options as scheduled in the hardware sets. Provide with number and gage of wires enough to accommodate electric function of specified hardware. Locate electric hinge at second hinge from bottom or nearest to electrified locking component. Provide mortar guard for each electrified hinge specified.

2.5 CYLINDRICAL LOCKS – GRADE 1

A. Manufacturers and Products: Grade 1 Heavy Duty Key-In Lever Cylindrical Locksets.

1. Best Lock: 9K Series with Stanley; 15D Lever by standard cylinders - (I/C cores may be used when authorized by AEC).
2. Marks USA; 195 Series with American Lever.
3. Sargent 10 Line Series with L Lever.
4. Schlage; ND Series with Rhodes (RHO) Lever.
5. Yale; 5400LN Series with Augusta (AU) Lever.

B. Requirements:

1. Provide cylindrical locks conforming to ANSI/BHMA A156.2 Series 4000, Grade 1, and UL Listed for 3-hour fire doors.
2. Comply with ADA requirements of ANSI A117.1 Accessibility Code.
3. Provide locks with standard 2-3/4 inches backset, unless noted otherwise, with 1/2-inch latch throw. Provide proper latch throw for UL listing at pairs.
4. Provide locksets with separate anti-rotation thru-bolts, and no exposed screws.
5. Provide independently operating levers with two external return spring cassettes mounted under roses to prevent lever sag.
6. Provide standard ASA strikes unless extended lip strikes are necessary to protect trim.
7. Lever Trim: Solid cast levers without plastic inserts and wrought roses on both sides.

a. Provide levers with vandal resistant technology for use at heavy traffic or abusive applications.

2.6 CYLINDERS

A. Manufacturers and Products:

1. Schlage; Everest with Primus Level 4+ keying system.

B. Requirements:

1. Provide cylinders/cores compliant with ANSI/BHMA A156.5; latest revision; cylinder face finished to match lockset; manufacturer’s series as indicated. Refer to “KEYING” article, herein.
2. Provide cylinders in the below-listed configuration(s), distributed throughout the Project as indicated.

a. Conventional Patented Open: cylinder with permanent core.

3. Patent Protection: Cylinders/cores requiring use of restricted, patented keys, patent protected.
4. Nickel silver bottom pins.

2.7 EXIT DEVICES

A. Manufacturers and Products:

1. Precision; Apex Series.
2. Sargent; 80 Series.
3. Von Duprin; 98 or 99 Rim Series.

B. Requirements:

1. Provide exit devices tested to ANSI/BHMA A156.3 Grade 1 and UL listed for Panic Exit or Fire Exit Hardware.
2. Provide entry by key with device locked by cylinder from outside. Key shall be removable when cylinder is in locked or unlocked position.
1. Provide smooth touchpad type exit devices, fabricated of brass, bronze, stainless steel, or aluminum, plated to standard architectural finishes to match balance of door hardware.
2. Touchpad must extend a minimum of one half of door width. No plastic inserts are allowed in touchpads.
3. Provide exit devices with deadlatching feature for security.
4. Provide exit devices with weather resistant components that can withstand harsh conditions of various climates and corrosive cleaners used in outdoor pool environments.
5. Provide flush end caps for exit devices.
6. Provide exit devices with Manufacturer's approved rim type strikes that allow installation of specified panic devices on specified storefront system.
7. Provide exit devices cut to door width and height. Install exit devices at height recommended by exit device manufacturer, allowable by governing building codes, and approved by Architect.
8. Mount mechanism case flush on face of doors or provide spacers to fill gaps behind devices. Where glass trim or molding projects off face of door, provide glass bead kits.
9. Provide dogging function by way of Manufacturer’s accessible thumbturn on entry doors, permanent knob on access doors, and do not provide dogging on emergency exit doors.
10. Provide factory drilled weep holes for exit devices used in full exterior application, highly corrosive areas, and where noted in hardware sets.
11. Top latch mounting: double- or single-tab mount for steel doors, face mount for aluminum doors eliminating requirement of tabs.
12. Provide exit devices with exterior trim matching other lever designs used on the project.

a. Exterior Lever Handle: Equal to Kawneer CO-9 or Arcadia OPR-9.

2.8 LOW ENERGY SWING DOOR OPERATOR

A. Manufacturers and Products:

1. Besam (subsidiary of ASSA ABLOY) US; Besam SW100.
2. Horton Automatics (Division of Overhead Door Corp.); Horton Series 7100 Low Energy.
3. Record-USA; Record 6100 Series Low Energy Swing Door Operator.
4. Stanley Access Technologies; Stanley Magic-Force.

B. Requirements:

1. Comply with requirements of ICC/ANSI 117.1 and BHMA A156.19.
2. Provide wall-mounted push button operation, interior.
3. Include 42 inch by 6 inch square bollard with push button operation, exterior.
4. Solid state electronic control.
5. Adjustable closing speed and hold-open range.
6. Automatic and manual operating modes.
7. Metal cover finished to match door.

2.9 KEYING

A. Requirements:

1. Construction Keying:

a. Replaceable Construction Cores.

1) Provide temporary construction cores replaceable by permanent cores, furnished in accordance with the following requirements.

a) 12 construction change (day) keys.

2) Owner or Owner's Representative will replace temporary construction cores with permanent cores.

2. Permanent Keying:

a. Provide permanent cylinders/cores keyed by the manufacturer according to the following key system.

1) Master Keying system as directed by the Owner.

b. Forward bitting list and keys separately from cylinders, by means as directed by Owner. Failure to comply with forwarding requirements will be cause for replacement of cylinders/cores involved at no additional cost to Owner.

c. Provide keys with the following features:

1) Material: Nickel silver; minimum thickness of .107-inch (2.3mm)
2) Patent Protection: Keys and blanks protected by one or more utility patent(s).

d. Identification:

1) Mark permanent cylinders/cores and keys with applicable blind code for identification. Do not provide blind code marks with actual key cuts.
2) Identification stamping provisions must be approved by the Architect and Owner.
3) Stamp cylinders/cores and keys with Owner's unique key system facility code as established by the manufacturer; key symbol and embossed or stamped with "DO NOT DUPLICATE" along with the "PATENTED" or patent number to enforce the patent protection.
4) Failure to comply with stamping requirements will be cause for replacement of keys involved at no additional cost to Owner.
5) Forward permanent cylinders/cores to Owner, separately from keys, by means as directed by Owner.

e. Quantity: Furnish in the following quantities.

1) Change (Day) Keys: 2 per cylinder/core.
2) Master Keys: 5 per group.
3) Grand Master Keys: 5
4) Control Key: 3

2.10 KEY CONTROL SYSTEM

A. Manufacturers:

a. HPC
b. Lund
c. Telkee

B. Requirements:

1. Provide key control system, including envelopes, labels, tags with self-locking key clips, receipt forms, 3-way visible card index, temporary markers, permanent markers, and standard metal cabinet, all as recommended by system manufacturer, with capacity for 150 percent of number of locks required for Project.

a. Provide complete cross index system set up by hardware supplier, and place keys on markers and hooks in cabinet as determined by final key schedule.
b. Provide hinged-panel type cabinet for wall mounting.
c. Provide cabinet with 20 hooks minimum.
d. Material and Finish: 20 ga steel with prime coat.
e. Provide cabinet with lock.

2.11 DOOR CLOSERS

A. Provide all closers from same Manufacturer:

B. Manufacturers and Products at Hollow Metal Frames:

1. Dorma Architectural Hardware; 8900 Series.
2. LCN Closers; 1461 Series. For aluminum entrances, 4041 Series.
3. Norton Door Controls; 8501 Series.
4. Sargent; 1431 Series.
5. Stanley (dormakaba Americas); D-3550/D-3551 Series.

C. Manufacturers and Products at Aluminum Entrances: Include Cush stop where wall stop is not used.

1. LCN Closers; 4041 Series.
2. Norton Door Controls; 7500 Series.
3. Dorma Architectural Hardware; Equal approved by Architect before bidding.
4. Sargent; Equal approved by Architect before bidding.
5. Stanley (dormakaba Americas); Equal approved by Architect before bidding.

A. Requirements:

1. Provide door closers conforming to ANSI/BHMA A156.4 Grade 1 requirements by BHMA certified independent testing laboratory. ISO 9000 certify closers. Stamp units with date of manufacture code.
2. Provide closers with the following features:

    a. Adjustable sweep speed.
    b. Adjustable backcheck.
    c. Non-handed and non-sized.
    d. Hold open arm function with thumb turn or handle control (Cush and Hold).

3. Provide parallel arms on closers unless door position in relation to adjacent wall requires otherwise. Provide covers for each closer arm.
4. Provide closers that allow for 100 degree opening with engaging stop function.
5. Provide door closers with fully hydraulic, full rack and pinion action with high strength cast iron cylinder, and full complement bearings at shaft.
6. Cylinder Body: 1-1/2-inch diameter piston with 5/8-inch diameter double heat-treated pinion journal. QR code with a direct link to maintenance instructions.
7. Hydraulic Fluid: Fireproof, passing requirements of UL10C, and requiring no seasonal closer adjustment for temperatures ranging from 120 degrees F to -30 degrees F.
8. Spring Power: Continuously adjustable over full range of closer sizes, and providing reduced opening force as required by accessibility codes and standards. Provide snap-on cover clip, with plastic covers, that secures cover to spring tube.
9. Hydraulic Regulation: By tamper-proof, non-critical valves, with separate adjustment for latch speed, general speed, and backcheck. Provide graphically labelled instructions on the closer body adjacent to each adjustment valve. Provide positive stop on reg valve that prevents reg screw from being backed out.
10. Provide closers with solid forged steel main arms and factory assembled heavy-duty forged forearms for parallel arm closers.
11. Pressure Relief Valve (PRV) Technology: Not permitted.
12. Finish for Closer Cylinders, Arms, Adapter Plates, and Metal Covers: Powder coating finish which has been certified to exceed 100 hours salt spray testing as described in ANSI Standard A156.4 and ASTM B117, or has special rust inhibitor (SRI).

13. Provide special templates, drop plates, mounting brackets, or adapters for arms as required for details, overhead stops, and other door hardware items interfering with closer mounting.

2.12 DOOR PUSHES AND PULLS

A. Manufacturers and Products:

1. Arcadia; PBR and OPR-9.
2. Kawneer; CP and CO-9.
3. Equal approved by Architect before bidding.

B. Requirements:

1. Provide push plates, push bars, pull plates, pulls, with diameter and length as scheduled.
2. Color: Match aluminum framing.

2.13 PROTECTION PLATES

A. Manufacturers:

1. Glynn-Johnson.
2. Hager.
3. Ives, Wallingford.
4. Rockwood Manufacturing Co.
5. Equal, as approved by Architect before installation.

A. Requirements:

1. Provide protection plates with a minimum of 0.050 inch thick stainless steel, beveled four edges as scheduled. Furnish with sheet metal or wood screws, finished to match plates.
2. Sizes Plates 10 inches high by width of door less 3/4 inch each side.

2.14 DOORSTOPS

A. Manufacturers and Products at Interior Walls:

1. Hager; 236W.
2. Ives; WS407CCV.
3. Rockwood Manufacturing Co.; 409.
4. Glynn-Johnson; equal as approved by Architect before installation.
5. Sargent; equal as approved by Architect before installation.

B. Manufacturers and Products at Exterior Walls:

1. Hager; 255W.
2. Ives; WS447.

3. Rockwood Manufacturing Co.; 474/475.
4. Glynn-Johnson; equal as approved by Architect before installation.
5. Sargent; equal as approved by Architect before installation.

C. Provide door stops at each door leaf:

1. Provide wall stops wherever possible. Provide concave type where lockset has a push button of thumbturn.

2.15 THRESHOLDS, SEALS, DOOR SWEEPS, AND GASKETING

A. Manufacturers and Products:

1. Smoke Gaskets: Color to be white,

a. NGP; 5050.
b. Pemko; PK 55.
c. Hager; 726.

2. Thresholds: At outswinging metal exterior doors.

a. NGP; 891 V.
b. Pemko; 185 V.
c. Hager; Equal as approved by Architect before bidding.

3. Thresholds: At exterior aluminum doors, exterior to carpet.

a. Pemko; 273.
b. NGP; Equal as approved by Architect before bidding.
c. Hager; Equal as approved by Architect before bidding.

4. Thresholds: At interior aluminum doors, carpet to carpet.

a. Pemko; 236.
b. NGP; Equal as approved by Architect before bidding.
c. Hager; Equal as approved by Architect before bidding.

5. Weatherstripping: Metal to be clear anodized aluminum.

a. NGP; A625 A.
b. Pemko; 35041 CP.
c. Hager; 800S.

6. Sweeps: At aluminum exterior doors. Include door manufacturer’s standard cover cap that has no exposed fasteners.

a. Pemko; 293100 N8.
b. NGP; Equal as approved by Architect before bidding.
c. Hager; Equal as approved by Architect before bidding.

B. Requirements:

1. Provide thresholds, weather-stripping, and gasketing systems as specified and per architectural details. Match finish of other items.
2. Smoke- and Draft-Control Door Assemblies: Where smoke- and draft-control door assemblies are required, provide door hardware that meets requirements of assemblies tested according to UL 1784 and installed in compliance with NFPA 105.
3. Provide door sweeps and seals only of type where resilient or flexible seal strip is easily replaceable and readily available.
4. Size thresholds to comply wit ADA, with 1/2 inch high by 5 inches wide by door width unless otherwise specified in the hardware sets or detailed in the drawings.

2.16 SILENCERS

A. Manufacturers:

a. Ives
b. Rockwood
c. Trimco

B. Requirements:

1. Provide "push-in" type silencers for hollow metal or wood frames.
2. Provide one silencer per 30 inches of height on each single frame, and two for each pair frame.
3. Omit where gasketing is specified.

2.17 FINISHES

A. BHMA 626; except:

1. Hinges at Exterior Doors: BHMA 630 (US32D).
2. Protection Plates: BHMA 630 (US32D)
3. Door Closers: Powder Coat to Match
4. Wall Stops: BHMA 630 (US32D)
5. Weatherstripping: Clear Anodized Aluminum
6. Thresholds: Mill Finish Aluminum

B. Finish materials, other than steel, brass, or bronze, to match appearance of satin chromium plated, except flat goods which shall be satin stainless steel.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Before ordering materials, examine Contract Documents to assure that material to be ordered is appropriate for thickness and substrate to which it is to be secured and will function as intended.

B. Prior to installation of hardware, examine doors and frames, with Installer present, for compliance with requirements for installation tolerances, wall and floor construction, and other conditions affecting performance. Verify doors, frames, and walls have been properly reinforced for hardware installation.

C. Examine roughing-in for electrical power systems to verify actual locations of wiring connections before electrified door hardware installation.

D. Submit a list of deficiencies in writing and proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Install using set of Manufacturer's installation, adjustment, and maintenance instructions.

B. Mount door hardware units at heights to comply with the following, unless otherwise indicated or required to comply with governing regulations.

1. Standard Steel Doors and Frames: ANSI/SDI A250.8.
2. Interior Architectural Wood Flush Doors: ANSI/WDMA I.S. 1A
3. Installation Guide for Doors and Hardware: DHI TDH-007-20

C. Install door hardware in accordance with NFPA 80, NFPA 101 and provide post-install inspection, testing as specified in section 1.03.E unless otherwise required to comply with governing regulations.

D. For wood doors, set hinges flush with edge surface. Set hinges in a straight line to prevent distortion. Mount door latches high in strike plate opening so when door later settles, latch will not bind.

E. Install each hardware item in compliance with manufacturer's instructions and recommendations, using only fasteners provided by manufacturer.

F. Do not install surface mounted items until finishes have been completed on substrate. Protect all installed hardware during painting.

G. Set units level, plumb and true to line and location. Adjust and reinforce attachment substrate as necessary for proper installation and operation.

H. Drill and countersink units that are not factory prepared for anchorage fasteners. Space fasteners and anchors according to industry standards.

I. Install operating parts so they move freely and smoothly without binding, sticking, or excessive clearance.

J. Hinges: Install types and in quantities indicated in door hardware schedule but not fewer than quantity recommended by manufacturer for application indicated.

K. Lock Cylinders:

1. Install construction cores to secure building and areas during construction period.
2. Replace construction cores with permanent cores as indicated in keying section.

L. Wiring: Coordinate with Division 26, ELECTRICAL and Division 28 ELECTRONIC SAFETY AND SECURITY sections for:

1. Conduit, junction boxes and wire pulls.
2. Connections to and from power supplies to electrified hardware.
3. Connections to fire/smoke alarm system and smoke evacuation system.
4. Connection of wire to door position switches and wire runs to central room or area, as directed by Architect.
5. Connections to panel interface modules, controllers, and gateways.
6. Testing and labeling wires with Architect's opening number.

M. Key Control System: Tag keys and place them on markers and hooks in key control system cabinet, as determined by final keying schedule.

1. Turn key cabinet over to Owner's designated representative at Substantial Completion with all keys required for every locking device on Project identified by tags and on hooks. Owner will install key cabinets.

N. Arrange to have keys brought to Project site and, in meeting attended by local representatives and Architect, test every new key and locking mechanism.

O. Closer: Mount closers on jamb stop side of doors wherever conditions permit in parallel arm configuration where it is physically possible to do so and not damage or hinder operation of door or closer. Use through-bolt hardware-to-door connections. Mount closers so they are not visible in corridors, lobbies and other public spaces unless approved by Architect.

P. Power Supplies: Locate power supplies as indicated or, if not indicated, above accessible ceilings or in equipment room, or alternate location as directed by Architect.

Q. Thresholds: Set thresholds in full bed of sealant complying with requirements specified in Section 09 7200 "Joint Sealants."

R. Stops: Provide floor stops for doors unless wall or other type stops are indicated in door hardware schedule. Do not mount floor stops where they may impede traffic or present tripping hazard.

S. Install smoke gaskets in manner to give continuous air-tight fit.

1. Install smoke gaskets as per Manufacturer’s installation requirements:

a. Hinge Jamb: Install smoke gaskets on jamb face of door frame so door will compress smoke gasket.
b. Header and Strike Jamb: Install smoke gaskets on face of stop of door frame so door will compress smoke gasket.

2. Perimeter Gasketing: Apply to head and jamb, forming seal between door and frame.
3. Meeting Stile Gasketing: Fasten to meeting stiles, forming seal when doors are closed.
4. Door Bottoms and Sweeps: Apply to bottom of door, forming seal with threshold when door is closed.

T. Correct work found defective or not complying with requirements, at no additional cost to the Owner.

3.3 ADJUSTING

A. Initial Adjustment: Adjust and check each operating item of door hardware and each door to ensure proper operation or function of every unit. Replace units that cannot be adjusted to operate as intended. Adjust door control devices to compensate for final operation of heating and ventilating equipment and to comply with referenced accessibility requirements.

1. Door Closers: Adjust sweep period to comply with accessibility requirements and requirements of authorities having jurisdiction. Adjust closers to provide maximum opening force as required by governing code authority and proper backcheck and sweep speed.

B. Occupancy Adjustment: Approximately three to six months after date of Substantial Completion, examine and readjust each item of door hardware, including adjusting operating forces, as necessary to ensure function of doors and door hardware.

3.4 CLEANING AND PROTECTION

1. Clean adjacent surfaces soiled by door hardware installation.
2. Clean operating items per manufacturer's instructions to restore proper function and finish.
3. Provide final protection and maintain conditions that ensure door hardware is without damage or deterioration at time of Substantial Completion.

3.5 DOOR HARDWARE SCHEDULE

A. The intent of the hardware specification is to specify the hardware for interior and exterior doors, and to establish a type, continuity, and standard of quality. However, it is the door hardware supplier's responsibility to thoroughly review existing conditions, schedules, specifications, drawings, and other Contract Documents to verify the suitability of the hardware specified.

B. Discrepancies, conflicting hardware, and missing items are to be brought to the attention of the architect with corrections made prior to the bidding process. Omitted items not included in a

hardware set should be scheduled with the appropriate additional hardware required for proper application.

C. Hardware items are referenced in the following hardware schedule. Refer to the above specifications for special features, options, cylinders/keying, and other requirements.

D. Hardware Sets:

HW GROUP: 1.0 Exterior entrance pairs of aluminum doors.

For use on Door #(s):
103A 105A

Each to have:

2	EA	CONT. HINGE	112XY		628	IVE
1	EA	MAGNETIC LOCK	M452P 12/24 VDC	✓	628	SCH
2	EA	LONG DOOR PULL	9264F 48" STD		630	IVE
1	EA	OH STOP	100S ADJ		630	GLY
1	EA	SURF. AUTO OPERATOR	4642 CS TBWMS 120 VAC	✓	689	LCN
2	EA	ACTUATOR, TOUCHLESS	8310-810DA	✓	630	LCN
2	EA	SURFACE CLOSER	SC1A RW/PA		689	FAL
2	EA	CLOSER BRACKETS	AS REQUIRED TO INSTALL CLOSERS		TBD	FAL
1	EA	WEATHERSTRIPPING	BY ALUMINUM DOOR/FRAME MANUFACTURER.			
1	EA	DOOR SWEEP	BY ALUMINUM DOOR/FRAME MANUFACTURER.			
1	EA	THRESHOLD	BY ALUMINUM DOOR/FRAME MANUFACTURER.			
1	EA	MULTITECH READER	BY SECURITY CONTRACTOR	✓	BLK	SCE
2	EA	PUSH TO EXIT BUTTON	DIV 28			
1	EA	DOOR CONTACT	7764	✓	628	SCE
1	EA	LOW VOLTAGE POWER	BY DIVISION 28.	✓		

HW GROUP: 2.0 Interior vestibule entrance pairs of aluminum doors.

For use on Door #(s):
103B 105B

Each to have:

2	EA	CONT. HINGE	112XY		628	IVE
2	EA	LONG DOOR PULL	9264F 48" STD		630	IVE
2	EA	FLOOR STOP	FS439		630	IVE
2	EA	SURF. AUTO OPERATOR	4642 CS TBWMS 120 VAC	✓	689	LCN
2	EA	ACTUATOR, TOUCHLESS	8310-810DA	✓	630	LCN
2	EA	SURFACE CLOSER	SC1A RW/PA		689	FAL
2	EA	CLOSER BRACKETS	AS REQUIRED TO INSTALL CLOSERS		TBD	FAL
1	EA	WEATHERSTRIPPING	BY ALUMINUM DOOR/FRAME MANUFACTURER.			
1	EA	MULTITECH READER	BY SECURITY CONTRACTOR	✓	BLK	SCE
2	EA	PUSH TO EXIT BUTTON	DIV 28			
1	EA	DOOR CONTACT	7764	✓	628	SCE
1	EA	LOW VOLTAGE POWER	BY DIVISION 28.	✓		

HW GROUP: 3.0 Exterior entrance single aluminum door.

For use on Door #(s):
122A

Each to have:

1	EA	CONT. HINGE	112XY	628	IVE
1	EA	LONG DOOR PULL	9264F 48" STD	630	IVE
1	EA	OH STOP	100S ADJ	630	GLY
1	EA	SURFACE CLOSER	SC1A RW/PA	689	FAL
1	EA	EXIT DEVICE	98 OR 99 RIM SERIES		VON
1	EA	CLOSER BRACKETS	AS REQUIRED TO INSTALL CLOSERS	TBD	FAL
1	EA	KICK PLATE	8400 10" X 2" LDW B-CS	630	IVE
1	EA	WEATHERSTRIPPING	BY ALUMINUM DOOR/FRAME MANUFACTURER.		
1	EA	DOOR SWEEP	BY ALUMINUM DOOR/FRAME MANUFACTURER.		
1	EA	THRESHOLD	BY ALUMINUM DOOR/FRAME MANUFACTURER.		

HW GROUP: 4.0 Interior vestibule entrance single aluminum door.

For use on Door #(s):
122B

Each to have:

1	EA	CONT. HINGE	112XY	628	IVE
1	EA	LONG DOOR PULL	9264F 48" STD	630	IVE
1	EA	OH STOP	100S ADJ	630	GLY
1	EA	SURFACE CLOSER	SC1A RW/PA	689	FAL
1	EA	CLOSER BRACKETS	AS REQUIRED TO INSTALL CLOSERS	TBD	FAL
1	EA	EXIT DEVICE	98 OR 99 RIM SERIES		VON
1	EA	KICK PLATE	8400 10" X 2" LDW B-CS	630	IVE
1	EA	WEATHERSTRIPPING	BY ALUMINUM DOOR/FRAME MANUFACTURER.		
1	EA	DOOR SWEEP	BY ALUMINUM DOOR/FRAME MANUFACTURER.		
1	EA	THRESHOLD	BY ALUMINUM DOOR/FRAME MANUFACTURER.		

HW GROUP: 5.0 Exterior hollow metal door.

For use on Door #(s):
125

Each to have:

3	EA	HINGE	5BB1 4.5 X 4.5 NRP	630	IVE
1	EA	STOREROOM LOCK	T581P6 LAT	626	FAL
1	EA	SURFACE CLOSER	SC71A SS	689	FAL
1	EA	KICK PLATE	8400 10" X 2" LDW B-CS	630	IVE
1	EA	WALL STOP	WS401/402CCV	626	IVE
1	EA	GASKETING	429AA-S	AA	ZER
1	EA	DOOR SWEEP	39A	A	ZER
1	EA	THRESHOLD	8655A-223	A	ZER

HW GROUP: 6.0 Interior doors

For use on Door #(s):
101 102 106

Each to have:

3	EA	HINGE (USE ELECTRIC HINGE FOR DOOR 101)	5BB1 4.5 X 4.5	652	IVE
1	EA	CLASSROOM LOCK (PROVIDE ELECTRIC LOCK/LATCH FOR DOOR 101)		626	FAL
1	EA	WALL STOP	WS401/402CCV	626	IVE
1	EA	SMOKE GASKETING			ZER
3	EA	SILENCER	SR64	GRY	IVE

HW GROUP: 7.0 Interior doors

For use on Door #(s):
110 111 112 113

Each to have:

3	EA	HINGE	5BB1 4.5 X 4.5	652	IVE
1	EA	PRIVACY W/DB & IND	L9496L 06A L583-363	626	SCH
1	EA	PUSH PLATE	8200 6" X 16"	630	IVE
1	EA	PULL PLATE	8305 8" 6" X 16"	630	IVE
1	EA	SURFACE CLOSER	4040XP EDA TBWMS	689	LCN
1	EA	WALL STOP	WS406/407CVX	630	IVE
1	EA	GASKETING	488SBK PSA	BK	ZER

HW GROUP: 8.0 Interior all-glass sliding (barn) door

For use on Door #(s):
130

Each to have:

1	EA	OPEN RAIL	ORG100 SINGLE DOOR 100OR-20 ORG100		BRI
1	EA	LONG DOOR PULL	PR 9266F 48" P	630-316	IVE

HW GROUP: 9.0 Interior lockable all-glass sliding (barn) door

For use on Door #(s):
131 132 133

Each to have:

1	EA	OPEN RAIL	ORG100 SINGLE DOOR 100OR-20 ORG100		BRI
1	EA	LONG DOOR PULL	PR 9266F 48" P	630-316	IVE
1	EA	OFFICE LOCK		630	FAL

HW GROUP: 10.0

For use on Door #(s):
120 121

Each to have:

3	EA	HINGE	5BB1 4.5 X 4.5	652	IVE
1	EA	UTILITY SPACE LOCK		626	FAL
1	EA	WALL STOP	WS401/402CCV	626	IVE
1	EA	SMOKE GASKETING			ZER
3	EA	SILENCER	SR64	GRY	IVE

END OF SECTION 08 7100

SECTION 08 8000 - GLAZING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Glass for windows, doors, and storefront framing.
2. Glazing sealants and accessories.
3. Decorative film overlays.

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 according to 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.

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 product.

B. Glass Samples: For each type of the following products; 12 inches square.

1. Each decorative film overlay on glass.

2. Coated glass.
3. Insulating glass.

C. Glazing Accessory Samples: For sealants and colored spacers, in 12-inch lengths. Install sealant Samples between two strips of material representative in color of the adjoining framing system.

D. Glazing Schedule: List glass types and thicknesses for each size opening and location. Use same designations indicated on Drawings.

E. Delegated-Design Submittal: For glass indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

1.6 INFORMATIONAL SUBMITTALS

A. Qualification Data: For Installer manufacturers of insulating-glass units with sputter-coated, low-E coatings and sealant testing agency.

B. Product Certificates: For glass.

C. Product Test Reports: For coated glass, insulating 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.

D. Sample Warranties: For special warranties.

1.7 QUALITY ASSURANCE

A. Manufacturer Qualifications for Insulating-Glass Units with Sputter-Coated, Low-E Coatings: A qualified insulating-glass manufacturer who is approved and certified by coated-glass manufacturer.

B. Installer Qualifications: A qualified installer who employs glass installers for this Project who are certified under the National Glass Association's Certified Glass Installer Program.

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.

E. Mockups: Build mockups to demonstrate aesthetic effects and to set quality standards for materials and execution.

1. Install glazing in mockups specified in Section 08 4113 "Aluminum-Framed Entrances and Storefronts" to match glazing systems required for Project, including glazing methods.
2. 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 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 the use of specially formulated primers.

1.9 DELIVERY, STORAGE, AND HANDLING

A. Protect glazing materials according to 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.

1.10 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.

1.11 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 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 the obstruction of vision by dust, moisture, or film on interior surfaces of glass.

1. Warranty Period: 10 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. Guardian Glass; SunGuard.
2. Viracon, Inc.
3. Vitro Architectural Glass.

B. Source Limitations for Glass: Obtain from single source from single manufacturer for each glass type.

C. Source Limitations for Glazing Accessories: Obtain from single source from single manufacturer for each product and installation method.

2.2 PERFORMANCE REQUIREMENTS

A. General: Installed glazing systems shall withstand normal thermal movement and wind and impact loads (where applicable) without failure, including loss or glass breakage attributable to the following: 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 01 4000 "Quality Requirements," to design glazing.

C. Structural Performance: Glazing shall withstand the following design loads within limits and under conditions indicated determined according to the IBC and ASTM E1300.

1. Design Wind Pressures:

a. As indicated on Drawings.
b. Design Wind Pressures: Determine design wind pressures applicable to Project according to ASCE/SEI 7, based on heights above grade indicated on Drawings.

1) Wind Design Data: As indicated on Drawings.

2. Design Snow Loads: As indicated on Drawings.
3. 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.
4. Differential Shading: Design glass to resist thermal stresses induced by differential shading within individual glass lites.

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 insulating-glass units, properties are based on units of thickness indicated for overall unit and for each lite.
3. U-Factors: Center-of-glazing values, according to NFRC 100 and based on LBL's WINDOW 5.2 computer program, expressed as Btu/sq. ft. x h x deg F.
4. Solar Heat-Gain Coefficient and Visible Transmittance: Center-of-glazing values, according to NFRC 200 and based on LBL's WINDOW 5.2 computer program.
5. Visible Reflectance: Center-of-glazing values, according to NFRC 300.

2.3 GLASS PRODUCTS, GENERAL

A. Glazing Publications: Comply with published recommendations 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. GANA Publications: "Glazing Manual."
2. IGMA Publication for Insulating Glass: SIGMA TM-3000, "North American Glazing Guidelines for Sealed Insulating Glass Units for Commercial and Residential Use."

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 shall indicate manufacturer's name, type of glass, thickness, and safety glazing standard with which glass complies.

C. Insulating-Glass Certification Program: Permanently marked either on spacers or on at least one component lite of units with appropriate certification label of IGCC.

D. Thickness: Where glass thickness is indicated, it is a minimum. Provide glass that complies with performance requirements and is not less than the thickness indicated.

1. Minimum Glass Thickness for Exterior Lites: 6 mm.

E. 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 DECORATIVE FILMS

A. Decorative Film: Translucent, dimensionally stable film, with pressure-sensitive clear adhesive back for adhering to glass and releasable protective backing.

1. Product: 3M Commercial Graphics Division; 3M™ Fasara™ Glass Finishes Frost/Matte, product as selected by Architect.
2. Applications: Interior glass doors and windows where indicated in Drawings.

B. Decorative Film Characteristics:

1. Adhesive Color: Clear.
2. Adhesive Type: Pressure-sensitive.
3. Application Method: Wet.
4. Backing: Acrylic Pressure Sensitive Adhesive.
5. Certifications: Class A - ASTM E84 Fire Classification.
6. Cleaning: Water-based.
7. Material: Polyester.
8. Opacity: Translucent.
9. Overall Thickness: 1.969 mil.

2.5 GLASS PRODUCTS

A. 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. Rollerwave peak to valley shall be 0.003 or below.

B. 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. Rollerwave peak to valley shall be 0.003 or below.

2.6 INSULATING GLASS

A. Insulating-Glass Units: Factory-assembled units consisting of sealed lites of glass separated by a dehydrated interspace, qualified according to ASTM E2190.

1. Sealing System: Dual seal, with manufacturer's standard primary and secondary sealants.
2. Perimeter Spacer: Aluminum with black, color anodic finish.

a. Products: Subject to compliance with requirements, provide one of the following:

1) Technoform; TGI-Spacer.
2) Thermix; a brand of Ensinger USA; Thermix.
3) Equal.

3. 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. Sealant shall have a VOC content of 250 g/L or less.
4. Colors of Exposed Glazing Sealants: As selected by Architect from manufacturer's full range.

B. Glazing Sealant:

1. Acid-curing silicone glazing sealant complying with ASTM C920, Type S, Grade NS, Class 25, Use NT.

a. Products: Subject to compliance with requirements, provide one of the following:

1) Bostik, Inc; Chem-Calk 1200.
2) Pecora Corporation; 860.

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 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 the 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, with requirements of manufacturers of glass and other glazing materials for application indicated, and with a proven record of compatibility with surfaces contacted in installation.

B. Cleaners, Primers, and Sealers: Types recommended by sealant or gasket manufacturer.

C. Setting Blocks:

1. Type recommended by sealant or glass manufacturer.

D. Spacers:

1. Neoprene blocks or continuous extrusions of hardness required by glass manufacturer to maintain glass lites in place for installation indicated.
2. Type recommended by sealant or glass manufacturer.

E. Edge Blocks:

1. Type recommended 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.

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 according to 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 by gasket manufacturer.

3.4 TAPE GLAZING

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.

3.5 GASKET GLAZING (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 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 by gasket manufacturer.

E. Install gaskets so they protrude past face of glazing stops.

3.6 SEALANT GLAZING (WET)

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 AND PROTECTION

A. Immediately after installation remove nonpermanent labels and clean surfaces.

B. 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 come into 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.

C. Remove and replace glass that is damaged during construction period.

D. 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 MONOLITHIC GLASS SCHEDULE

A. Glass Type GL-3: Clear fully tempered float glass.

1. Minimum Thickness: 6 mm.
2. Safety glazing required.

3.9 INSULATING GLASS SCHEDULE

A. Glass Type GL-1: Low-E-coated, clear insulating tempered glass.

1. Basis-of-Design Product: Vitro Architectural Glass; Solarban 70, or equal.
2. Overall Unit Thickness: 1 inch.
3. Minimum Thickness of Outdoor Lite: 6 mm.
4. Outdoor Lite: Fully tempered float glass.
5. Interspace Content: Argon.
6. Indoor Lite: Fully tempered float glass.
7. Low-E Coating: Sputtered on second surface.
8. Winter Nighttime U-Factor: 0.28 maximum.
9. Visible Light Transmittance: 64 percent minimum.
10. Solar Heat Gain Coefficient: 0.27 maximum.
11. Safety glazing required.
12. Locations: Typical exterior windows and storefront.

B. Glass Type GL-2: Low-E-coated, clear insulating heat-strengthened glass.

1. Basis-of-Design Product: Vitro Architectural Glass; Solarban 70, or equal.
2. Overall Unit Thickness: 1 inch.
3. Minimum Thickness of Outdoor Lite: 6 mm.

4. Outdoor Lite: Heat-strengthened float glass.
5. Interspace Content: Argon.
6. Indoor Lite: Heat-strengthened float glass.
7. Winter Nighttime U-Factor: 0.28 maximum.
8. Visible Light Transmittance: 64 percent minimum.
9. Solar Heat Gain Coefficient: 0.27 maximum.
10. Locations: Exterior windows and storefront 60 inches or more above floor.

END OF SECTION 08 8000

SECTION 09 2900 - GYPSUM BOARD

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Interior gypsum board.
2. Tile backing panels.

B. Related Requirements:

1. Section 07 9219 "Acoustical Joint Sealants" for acoustical joint sealants installed in gypsum board assemblies.

1.2 ACTION SUBMITTALS

A. Product Data: For the following:

1. Gypsum board, Type X.
2. Mold-resistant gypsum board.
3. Cementitious backer units.
4. Interior trim.
5. Joint treatment materials.
6. Sound-attenuation blankets.

1.3 QUALITY ASSURANCE

A. Mockups: 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 gypsum board finish indicated for use in exposed locations.

2. Apply or install final decoration indicated, including painting and wallcoverings, on exposed surfaces for review of mockups.
3. Simulate finished lighting conditions for review of mockups.
4. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

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 gypsum board 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, and 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 panel 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. STC-Rated Assemblies: For STC-rated assemblies, provide materials and construction identical to those tested in assembly indicated according to ASTM E90 and classified according to ASTM E413 by an independent testing agency.

2.3 GYPSUM BOARD, GENERAL

A. Size: Provide maximum lengths and widths available that will minimize joints in each area and that correspond with support system indicated.

2.4 INTERIOR GYPSUM BOARD

A. Gypsum Board, Type X: ASTM C1396/C1396M.

1. Products: Subject to compliance with requirements, provide one of the following:

a. American Gypsum; 5/8" FireBloc® Type X Gypsum Wallboard.

b. CertainTeed Gypsum; CertainTeed Type X Gypsum Board.
c. National Gypsum Company; Gold Bond® Fire-Shield® Gypsum Board.
d. USG Corporation; USG Imperial® Gypsum Base, Firecode® X or USG Sheetrock® Brand UltraLight Panels Firecode® X.

2. Thickness: 5/8 inch.
3. Long Edges: Tapered.

B. Mold-Resistant Gypsum Board: ASTM C1396/C1396M. With moisture- and mold-resistant core and paper surfaces.

1. Products: Subject to compliance with requirements, provide one of the following:

a. American Gypsum; 5/8" M-Bloc® Type X with Mold & Moisture Resistance.
b. CertainTeed; SAINT-GOBAIN; CertainTeed M2Tech Mold and Moisture Resistant Type X Gypsum Board.
c. Gold Bond Building Products, LLC provided by National Gypsum Company; Gold Bond® XP® Gypsum Board.
d. USG Corporation; USG Sheetrock® Brand EcoSmart Panels Mold Tough® Firecode® X.

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.

2.5 TILE BACKING PANELS

A. Cementitious Backer Units: ANSI A118.9 and ASTM C1288 or ASTM C1325, with manufacturer's standard edges.

1. Products: Subject to compliance with requirements, provide one of the following:

a. CertainTeed Corporation; FiberCement BackerBoard.
b. Custom Building Products; Wonderboard.
c. FinPan, Inc; EZ Backer.
d. James Hardie Building Products, Inc.; Hardiebacker.
e. National Gypsum Company; PermaBase® Cement Board.
f. USG Corporation; DUROCK Cement Board.

2. Thickness: 5/8 inch.
3. Mold Resistance: ASTM D3273, score of 10 as rated according to ASTM D3274.

2.6 TRIM ACCESSORIES

A. Interior Trim: ASTM C1047.

1. Material: Galvanized or aluminum-coated steel sheet, rolled zinc, plastic, or paper-faced galvanized-steel sheet.

2. Shapes:

    a. Cornerbead.
    b. LC-Bead: J-shaped; exposed long flange receives joint compound.
    c. L-Bead: L-shaped; exposed long flange receives joint compound.
    d. Expansion (control) joint.

2.7 JOINT TREATMENT MATERIALS

A. General: Comply with ASTM C475/C475M.

B. Joint Tape:

1. Interior Gypsum Board: Paper.
2. Tile Backing Panels: As recommended by panel manufacturer.

C. Joint Compound for Interior Gypsum Board: For each coat, use formulation that is compatible with other compounds applied on previous or for successive coats.

1. Prefilling: At open joints and damaged surface areas, use setting-type taping compound.
2. Embedding and First Coat: For embedding tape and first coat on joints, fasteners, and trim flanges, use setting-type taping compound.

    a. Use setting-type compound for installing paper-faced metal trim accessories.

3. Fill Coat: For second coat, use setting-type, sandable topping compound.
4. Finish Coat: For third and fourth coat, use drying-type, all-purpose compound.

D. Joint Compound for Tile Backing Panels:

1. Cementitious Backer Units: As recommended by backer unit manufacturer.

2.8 AUXILIARY MATERIALS

A. Provide auxiliary materials that comply with referenced installation standards and manufacturer's written instructions.

B. Steel Drill Screws: ASTM C1002 unless otherwise indicated.

1. Use screws complying with ASTM C954 for fastening panels to steel members from 0.033 to 0.112 inch thick.
2. For fastening cementitious backer units, use screws of type and size recommended by panel manufacturer.

C. Sound-Attenuation Blankets: ASTM C665, Type I (blankets without membrane facing) produced by combining thermosetting resins with mineral fibers manufactured from glass, slag wool, or rock wool.

D. Acoustical Sealant: As specified in Section 07 9219 "Acoustical Joint Sealants."

1. Sealant shall have a VOC content of 250 g/L or less.

E. Thermal Insulation: As specified in Section 07 2100 "Thermal Insulation."

F. Vapor Retarder: As specified in Section 07 2600 "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, and mold damaged.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION AND FINISHING OF PANELS, GENERAL

A. Comply with ASTM C840.

B. Install ceiling panels across framing to minimize the number of abutting end joints and to avoid abutting end joints in central area of each ceiling. Stagger abutting end joints of adjacent panels not less than one framing member.

C. Install panels with face side out. Butt panels together for a light contact at edges and ends with not more than 1/16 inch of open space between panels. Do not force into place.

D. Locate edge and end joints over supports, except in ceiling applications where intermediate supports or gypsum board back-blocking is provided behind end joints. Do not place tapered edges against cut edges or ends. Stagger vertical joints on opposite sides of partitions. Do not make joints other than control joints at corners of framed openings.

E. Form control and expansion joints with space between edges of adjoining gypsum panels.

F. Cover both faces of support framing with gypsum panels in concealed spaces (above ceilings, etc.), except in chases braced internally.

1. Unless concealed application is indicated or required for sound, fire, air, or smoke ratings, coverage may be accomplished with scraps of not less than 8 sq. ft. 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. 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.

I. STC-Rated Assemblies: Seal construction at perimeters, behind control joints, and at openings and penetrations with a continuous bead of acoustical sealant. Install acoustical sealant at both faces of partitions at perimeters and through penetrations. Comply with ASTM C919 and with manufacturer's written instructions for locating edge trim and closing off sound-flanking paths around or through assemblies, including sealing partitions above acoustical ceilings.

J. 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. Install interior gypsum board in the following locations:

1. Type X: Walls and ceilings indicated on Drawings.
2. Mold-Resistant Type: Restrooms where no tile.

B. Single-Layer Application:

1. On ceilings, apply gypsum panels before wall/partition board application to greatest extent possible and at right angles to framing unless otherwise indicated.
2. On partitions/walls, apply gypsum panels horizontally (perpendicular to framing) unless otherwise indicated or required by fire-resistance-rated assembly, and minimize end joints.

    a. Stagger abutting end joints not less than one framing member in alternate courses of panels.

3. Fastening Methods: Apply gypsum panels to supports with steel drill screws.

3.4 INSTALLATION OF TILE BACKING PANELS

A. Cementitious Backer Units: ANSI A108.11, at locations indicated to receive tile.

B. Where tile backing panels abut other types of panels in same plane, shim surfaces to produce a uniform plane across panel surfaces.

3.5 INSTALLATION OF TRIM ACCESSORIES

A. General: For trim with back flanges intended for fasteners, attach to framing with same fasteners used for panels. Otherwise, attach trim according to manufacturer's written instructions.

B. Control Joints: Install control joints at locations indicated on Drawings, or if not indicated, according to ASTM C840 and in specific locations approved by Architect for visual effect.

C. Interior Trim: Install in the following locations:

1. Cornerbead: Use at outside corners unless otherwise indicated.

3.6 FINISHING GYPSUM BOARD

A. General: Treat gypsum board joints, interior angles, edge trim, control joints, penetrations, fastener heads, surface defects, and elsewhere as required to prepare gypsum board surfaces for decoration. Promptly remove residual joint compound from adjacent surfaces.

B. Prefill open joints and damaged surface areas.

C. Apply joint tape over gypsum board joints, except for trim products specifically indicated as not intended to receive tape.

D. Gypsum Board Finish Levels: Finish panels to levels indicated below and according to ASTM C840:

1. Level 1: Ceiling plenum areas, concealed areas, and where indicated.
2. Level 4: At panel surfaces that will be exposed to view unless otherwise indicated.

a. Primer and its application to surfaces are specified in Section 09 9123 "Interior Painting."

E. Cementitious Backer Units: Finish according to manufacturer's written instructions.

3.7 PROTECTION

A. Protect adjacent surfaces from drywall compound and promptly remove from floors and other non-drywall surfaces. Repair surfaces stained, marred, or otherwise damaged during drywall application.

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 are wet, moisture damaged, and 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 2900

SECTION 09 3013 - CERAMIC TILING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Ceramic mosaic tile.
2. Porcelain tile.
3. Metal edge strips.

B. Related Requirements:

1. Section 07 9200 "Joint Sealants" for sealing of expansion, contraction, control, and isolation joints in tile surfaces.
2. Section 09 2900 "Gypsum Board" for cementitious backer units.

1.2 DEFINITIONS

A. General: Definitions in the ANSI A108 series of tile installation standards and in ANSI A137.1 apply to Work of this Section unless otherwise specified.

B. ANSI A108 Series: ANSI A108.01, ANSI A108.02, ANSI A108.1A, ANSI A108.1B, ANSI A108.1C, ANSI A108.4, ANSI A108.5, ANSI A108.6, ANSI A108.8, ANSI A108.9, ANSI A108.10, ANSI A108.11, ANSI A108.12, ANSI A108.13, ANSI A108.14, ANSI A108.15, ANSI A108.16, and ANSI A108.17, which are contained in its "Specifications for Installation of Ceramic Tile."

C. Face Size: Actual tile size, excluding spacer lugs.

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 product.

B. Shop Drawings: Show locations of each type of tile and tile pattern. Show widths, details, and locations of expansion, contraction, control, and isolation joints in tile substrates and finished tile surfaces.

C. Samples for Initial Selection: For grout and accessories involving color selection.

D. 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. Metal edge strips in 6-inch lengths.

1.5 INFORMATIONAL SUBMITTALS

A. Qualification Data: For Installer.

B. Master Grade Certificates: For each shipment, type, and composition of tile, signed by tile manufacturer and Installer.

C. Product Certificates: For each type of product.

D. Product Test Reports: For tile-setting and -grouting products and certified porcelain tile.

1.6 MAINTENANCE MATERIAL SUBMITTALS

A. Furnish extra materials that match and are from same production runs as 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 3 percent of amount installed for each type, composition, color, pattern, and size indicated.
2. Grout: Furnish quantity of grout equal to 3 percent of amount installed for each type, composition, and color indicated.

1.7 QUALITY ASSURANCE

A. Installer Qualifications:

1. Installer is a Five-Star member of the National Tile Contractors Association or a Trowel of Excellence member of the Tile Contractors' Association of America.

2. Installer's supervisor for Project holds the International Masonry Institute's Foreman Certification.
3. 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.
4. Installer employs at least one installer for Project that has completed the Advanced Certification for Tile Installers (ACT) certification for installation of membranes, gauged porcelain tile/gauged porcelain tile panels and slabs and large format tile.

B. Mockups: Build mockups to verify selections made under Sample submittals and to demonstrate aesthetic effects and set quality standards for materials and execution.

1. Build mockup of each type of floor tile installation.
2. Build mockup of wall tile installation.
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. 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.

1.9 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.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Source Limitations for Tile: Obtain tile of each type 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. Source Limitations for Setting and Grouting Materials: Obtain ingredients of a uniform quality for each mortar, adhesive, and grout component from single manufacturer and each aggregate from single source or producer.

1. Obtain setting and grouting materials, except for unmodified Portland cement and aggregate, from single manufacturer.
2. Obtain waterproof membrane, except for sheet products, from manufacturer of setting and grouting materials.

C. Source Limitations for Other Products: Obtain each of the following products specified in this Section from a single manufacturer:

1. Metal edge strips.

2.2 PRODUCTS, 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 in wet areas, do not use back- or edge-mounted tile assemblies unless tile manufacturer specifies in writing that this type of mounting is suitable for installation indicated and has a record of successful in-service performance.

2.3 TILE PRODUCTS

A. Ceramic Floor Tile Type F3: Large format porcelain tile.

1. Basis-of-Design Product: Item F3 (WOW; R9 Chevron Floor, 113936) as indicated on Finish Legend in the Drawings.

a. Subject to compliance with requirements, provide Item F3 porcelain tiles or equivalent products approved by Architect prior to bid by another manufacturer.

2. Certification: Tile certified by the Porcelain Tile Certification Agency.

3. Face Size: 4 by 20-1/2 inches, as indicated on Finish Legend.
4. Face Size Variation: Rectified.
5. Face: Plain with square or cushion edges.
6. Dynamic Coefficient of Friction: Not less than 0.42.
7. Tile Color, Glaze, and Pattern: As indicated on Finish Legend.
8. Grout Color: As indicated on Finish Legend.
9.

B. Ceramic Floor Tile Type F4: Factory-mounted ceramic tile.

1. Basis of Design Product: Provide Item F4 (Daltile; Keystone) indicated on Finish Legend in the Drawings.

    a. Subject to compliance with requirements, provide Items F4 or equivalent products approved by Architect prior to bid by another manufacturer.

2. Composition: Impervious natural clay or porcelain.
3. Certification: Porcelain tile certified by the Porcelain Tile Certification Agency.
4. Module Size: As indicated on Finish Legend.
5. Thickness: 1/4 inch.
6. Face: Plain with cushion edges.
7. Surface: Smooth, without abrasive admixture.
8. Dynamic Coefficient of Friction: Not less than 0.42.
9. Tile Color and Pattern: As indicated on Finish Schedule.
10. Grout Color: As indicated on Finish Legend.

C. Ceramic Floor Tile Type W6: Factory-mounted ceramic wall tile.

1. Basis of Design Product: Provide Item W6 (Daltile; Retrospace Remix) indicated on Finish Legend in the Drawings.

    a. Subject to compliance with requirements, provide Item W6 or equivalent products approved by Architect prior to bid by another manufacturer.

2. Composition: Impervious natural clay or porcelain.
3. Certification: Porcelain tile certified by the Porcelain Tile Certification Agency.
4. Module Size: 6 by 6 inch hexagon, as indicated on Finish Legend.
5. Face: Plain with cushion edges.
6. Surface: Smooth, without abrasive admixture.
7. Dynamic Coefficient of Friction: Not less than 0.42.
8. Tile Color and Pattern: As indicated on Finish Legend.
9. Grout Color: As indicated on Finish Legend.

D. Ceramic Wall Tile Type W7: Large Format Tile.

1. Provide Item W7 (Daltile; Color Wheel) indicated on Finish Legend in the Drawings.

    a. Subject to compliance with requirements, provide Item W7 or equivalent products approved by Architect prior to bid by another manufacturer.

2. Certification: Tile certified by the Porcelain Tile Certification Agency.
3. Face Size: As indicated on Finish Legend.
4. Face Size Variation: Rectified.
5. Face: Plain with square or cushion edges.
6. Dynamic Coefficient of Friction: Not less than 0.42.
7. Tile Color and Pattern: As indicated on Finish Legend.
8. Grout Color: As indicated on Finish Legend.

E. Ceramic Wall Tile Type M1: Tile on Millwork.

1. Basis-of-Design Product: Item M1 (Laminam; Naturali) as indicated on Finish Legend in the Drawings.

    a. Subject to compliance with requirements, provide Tile CT3 or equivalent products approved by Architect prior to bid by another manufacturer.

2. Certification: Tile certified by the Porcelain Tile Certification Agency.
3. Face Size: As indicated on Finish Legend.
4. Face Size Variation: Rectified.
5. Face: Plain with square or cushion edges.
6. Tile Color and Pattern: As indicated on Finish Legend.
7. Grout Color: As indicated on Finish Legend.

2.4 SETTING MATERIALS

A. Medium-Bed, Modified Dry-Set Mortar: Comply with requirements in ANSI A118.4. Provide product that is approved by manufacturer for application thickness of 5/8 inch.

1. Products: Subject to compliance with requirements, provide one of the following:

    a. Custom Building Products; Complete Contact-LFT Premium Rapid Setting Large Format Tile Mortar.
    b. MAPEI Corporation; Ultraflex™ LFT Rapid.

B. Improved Modified Dry-Set Mortar (Thinset): ANSI A118.15.

1. Products: Subject to compliance with requirements, provide one of the following:

    a. ARDEX Americas; ARDEX S 28™ MICROTEC® Rapid-Set, Rapid-Dry, Super-Format Tile and Uncoupling Membrane Mortar.
    b. Custom Building Products; FlexBond® Premium Crack Prevention Thin-set Mortar.
    c. Laticrete International, Inc.; LATICRETE 254 Platinum.
    d. MAPEI Corporation; Ultraflex™ 1.

2. For wall applications, provide mortar that complies with requirements for nonsagging mortar in addition to the other requirements in ANSI A118.15.

2.5 GROUT MATERIALS

A. Water-Cleanable Epoxy Grout: ANSI A118.3, with a VOC content of 65 g/L or less.

1. Products: Subject to compliance with requirements, provide one of the following:

    a. ARDEX Americas; ARDEX WA™ High Performance, 100% Solids Epoxy Grout and Adhesive.
    b. Custom Building Products; CEG--Lite™ 100% Solids Commercial Epoxy Grout.
    c. Laticrete International, Inc.; LATICRETE SPECTRALOCK® 2000 IG.
    d. MAPEI Corporation; Kerapoxy CQ.

2. Provide product capable of withstanding continuous and intermittent exposure to temperatures of up to 140 and 212 deg F, respectively, and certified by manufacturer for intended use.

B. Grout for Pregrouted Tile Sheets: Same product used in factory to pregrout tile sheets.

2.6 MISCELLANEOUS MATERIALS

A. Trowelable Underlayments and Patching Compounds: Latex-modified, portland cement-based formulation provided or approved by manufacturer of tile-setting materials for installations indicated.

B. Metal Edge Strips: Angle or L-shaped, height to match tile and setting-bed thickness, metallic or combination of metal and PVC or neoprene base, designed specifically for flooring applications; stainless steel, ASTM A276/A276M or ASTM A666, 300 Series exposed-edge material.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

    a. Blanke Corporation.
    b. Ceramic Tool Company, Inc.
    c. Schluter Systems L.P.

2. Floor to Wall Transitions: Item B2 on Finish Legend.

    a. Basis of Design: Schluter Systems L.P; DILEX.

3. Edge Transitions: Item W9 on Finish Legend.

    a. Basis of Design: Schluter Systems L.P; Jolly-P.

C. Tile Cleaner: A neutral cleaner capable of removing soil and residue without harming tile and grout surfaces, specifically approved for materials and installations indicated by tile and grout manufacturers.

2.7 MIXING MORTARS AND GROUT

A. Mix mortars and grouts to comply with referenced standards and mortar and grout manufacturers' written instructions.

B. Add materials, water, and additives in accurate proportions.

C. 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.

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 bonded mortar bed 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. Where indicated, prepare substrates to receive waterproof membrane by applying a reinforced mortar bed that complies with ANSI A108.1A and is sloped 1/4 inch per foot toward drains.

B. Blending: For tile exhibiting color variations, verify that tile has been factory blended and packaged so tile units taken from one package show same range of colors as those taken from other packages and match approved Samples. If not factory blended, either return to manufacturer or blend tiles at Project site before installing.

3.3 INSTALLATION OF CERAMIC TILE

A. Comply with TCNA's "Handbook for Ceramic, Glass, and Stone Tile Installation" for TCNA installation methods specified in tile installation schedules. Comply with parts of the ANSI A108 series "Specifications for Installation of Ceramic Tile" that are referenced in TCNA installation methods, specified in tile installation schedules, and apply to types of setting and grouting materials used.

1. For the following installations, follow procedures in the ANSI A108 series of tile installation standards for providing 95 percent mortar coverage:

a. Tile floors consisting of tiles 8 by 8 inches or larger.
b. Tile floors consisting of rib-backed tiles.

B. Extend tile work into recesses and under or behind equipment and fixtures to form complete covering without interruptions unless otherwise indicated. Terminate work neatly at obstructions, edges, and corners without disrupting pattern or joint alignments.

C. Accurately form intersections and returns. Perform cutting and drilling of tile without marring visible surfaces. Carefully grind cut edges of tile abutting trim, finish, or built-in items for straight aligned joints. Fit tile closely to electrical outlets, piping, fixtures, and other penetrations so plates, collars, or covers overlap tile.

D. Provide specified metal trim to eliminate exposed tile edges.

E. Jointing Pattern: Lay tile in grid pattern unless otherwise indicated. Lay out tile work and center tile fields in both directions in each space or on each wall area. Lay out tile work to minimize the use of pieces that are less than half of a tile. Provide uniform joint widths unless otherwise indicated.

1. For tile mounted in sheets, make joints between tile sheets same width as joints within tile sheets so joints between sheets are not apparent in finished work.
2. Where adjoining tiles on floor, base, walls, or trim are specified or indicated to be same size, align joints.
3. Where tiles are specified or indicated to be whole integer multiples of adjoining tiles on floor, base, walls, or trim, align joints unless otherwise indicated.

F. Joint Widths: Do not exceed width of 1/8 inch. Unless otherwise indicated, install tile with the following joint widths:

1. Ceramic Mosaic Tile: 1/16 inch.
2. Porcelain Tile: 1/8 inch.

G. Expansion Joints: Provide expansion joints and other sealant-filled joints, including control, contraction, and isolation joints, where indicated and as approved on Shop Drawings, and in compliance with EJ171 “Movement Joint Guidelines for Ceramic, Glass, and Stone” of the latest version on TCNA's "Handbook for Ceramic, Glass, and Stone Tile Installation". Form joints during installation of setting materials, mortar beds, and tile. Do not saw-cut joints after installing tiles.

1. Where joints occur in concrete substrates, locate joints in tile surfaces directly above them.
2. Match size of expansion joint profile with thickness of tile.

H. Metal Edge Strips: Install at locations indicated.

3.4 INSTALLATION OF TILE BACKING PANEL

A. Install panels and treat joints according to ANSI A108.11 and manufacturer's written instructions for type of application indicated.

3.5 ADJUSTING AND CLEANING

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.

B. Cleaning: On completion of placement and grouting, clean all ceramic tile surfaces so they are free of foreign matter.

1. Remove grout residue from tile as soon as possible.
2. Clean grout smears and haze from tile according to tile and grout manufacturer's written instructions but no sooner than 10 days after installation. Use only cleaners recommended by tile and grout manufacturers and only after determining that cleaners are safe to use by testing on samples of tile and other surfaces to be cleaned. Protect metal surfaces and plumbing fixtures from effects of cleaning. Flush surfaces with clean water before and after cleaning.

3.6 PROTECTION

A. Protect installed tile work with kraft paper or other heavy covering during construction period to prevent staining, damage, and wear. If recommended by tile manufacturer, apply coat of neutral protective cleaner to completed tile walls and floors.

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.

3.7 INTERIOR CERAMIC TILE INSTALLATION SCHEDULE

A. Interior Floor Installations, Concrete Subfloor:

1. Ceramic Tile Installation: TCNA F111 and ANSI A108.1C; cement mortar bed (thickset) with cleavage membrane.

a. Ceramic Tile Type: Large format tile.
b. Bond Coat for Cured-Bed Method: Medium-bed, modified dry-set mortar.
c. Grout: Water-cleanable epoxy grout.

2. Ceramic Tile Installation: TCNA F114 and ANSI A108.1C; cement mortar bed (thickset) with cleavage membrane; epoxy grout.

a. Ceramic Tile Type: 2 by 4 inch tile.
b. Bond Coat for Cured-Bed Method: Improved modified dry-set mortar.
c. Grout: Water-cleanable epoxy grout.

B. Interior Wall Installations, Wood Studs:

1. Ceramic Tile Installation: TCNA W244C or TCNA W244F; thinset mortar on cementitious backer units.

a. Ceramic Tile Type: Wall tiles.
b. Thinset Mortar: Improved modified dry-set mortar.
c. Grout: Water-cleanable epoxy grout.

END OF SECTION 09 3013

SECTION 09 5113 - ACOUSTICAL PANEL CEILINGS

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes acoustical panels and exposed suspension systems for interior ceilings.

B. Products furnished, but not installed under this Section, include anchors, clips, and other ceiling attachment devices to be cast in concrete.

1.2 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

1.4 INFORMATIONAL SUBMITTALS

A. Coordination Drawings: Reflected ceiling plans, drawn to scale, on which the following items are shown and coordinated with each other, using input from installers of the items involved:

1. Ceiling suspension-system members.
2. Structural members to which suspension systems will be attached.
3. Method of attaching hangers to building structure.

    a. Furnish layouts for cast-in-place anchors, clips, and other ceiling attachment devices whose installation is specified in other Sections.

4. Carrying channels or other supplemental support for hanger-wire attachment where conditions do not permit installation of hanger wires at required spacing.
5. Size and location of initial access modules for acoustical panels.
6. Items penetrating finished ceiling and ceiling-mounted items including the following:

    a. Lighting fixtures.
    b. Diffusers.
    c. Grilles.
    d. Speakers.
    e. Sprinklers.
    f. Access panels.
    g. Perimeter moldings.

7. Show operation of hinged and sliding components covered by or adjacent to acoustical panels.
8. Minimum Drawing Scale: 1/4 inch = 1 foot.

B. Qualification Data: For testing agency.

C. Product Test Reports: For each acoustical panel ceiling, for tests performed by a qualified testing agency.

D. Evaluation Reports: For each acoustical panel ceiling suspension system and anchor and fastener type, from ICC-ES.

E. Field quality-control reports.

1.5 CLOSEOUT SUBMITTALS

A. Maintenance Data: For finishes to include in maintenance manuals.

1.6 MAINTENANCE MATERIAL SUBMITTALS

A. Furnish extra materials, from the same product run, that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Acoustical Ceiling Units: Full-size panels equal to 2 percent of quantity installed.
2. Suspension-System Components: Quantity of each exposed component equal to 2 percent of quantity installed.
3. Impact Clips: Equal to 2 percent of quantity installed.

1.7 QUALITY ASSURANCE

A. Mockups: 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 in location as directed by Architect.
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.

B. Where conflicting information is found in the Construction Documents related to products, details or dimensional discrepancies, comply with the most stringent requirements regardless of cost.

1.8 DELIVERY, STORAGE, AND HANDLING

A. Deliver acoustical panels, 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 panels, permit them to reach room temperature and a stabilized moisture content.

1.9 FIELD CONDITIONS

A. Environmental Limitations: Do not install acoustical panel 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.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Source Limitations: Obtain each type of acoustical ceiling panel and its supporting suspension system from single source from single manufacturer.

2.2 PERFORMANCE REQUIREMENTS

A. Delegated Design: Engage a qualified professional engineer, as defined in Section 01 4000 "Quality Requirements," to design seismic restraints for ceiling systems.

B. Seismic Performance: Suspended ceilings shall withstand the effects of earthquake motions determined according to ASCE/SEI 7.

C. 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 according to ASTM E1264.
2. Smoke-Developed Index: 50 or less.

2.3 TYPICAL ACOUSTICAL PANELS

A. Basis of Design: Item C2 as indicated in the Finish Legend in the Drawings.

1. Provide Basis of Design Product or an equivalent product, approved by Architect prior to bid, by another manufacturer.

B. Acoustical Panel Standard: Provide manufacturer's standard panels according to ASTM E1264 and designated by type, form, pattern, acoustical rating, and light reflectance unless otherwise indicated.

C. Classification: Provide panels as follows:

1. Type and Form: Type IV, mineral base with membrane-faced overlay; Form 2, water felted.
2. Pattern: E (lightly textured).

D. Color: White.

E. Ceiling Attenuation Class (CAC): Not less than 35.

F. Noise Reduction Coefficient (NRC): Not less than 0.85.

G. Edge/Joint Detail: Reveal sized to fit flange of exposed suspension-system members.

H. Thickness: 1 inch.

I. Modular Size: 24 by 24 inches.

J. Antimicrobial Treatment: Manufacturer's standard broad spectrum, antimicrobial formulation that inhibits fungus, mold, mildew, and gram-positive and gram-negative bacteria and showing no mold, mildew, or bacterial growth when tested according to ASTM D3273, ASTM D3274, or ASTM G21 and evaluated according to ASTM D3274 or ASTM G21.

2.4 METAL SUSPENSION SYSTEM

A. Basis of Design: Item C1 as indicated in the Finish Legend in the Drawings.

1. Provide Basis of Design Product or an equivalent product, approved by Architect prior to bid, by another manufacturer.

B. Metal Suspension-System Standard: Provide manufacturer's standard, direct-hung, metal suspension system and accessories according to ASTM C635/C635M and designated by type, structural classification, and finish indicated.

C. Narrow-Face, Capped, Double-Web, Steel Suspension System: Main and cross runners roll formed from cold-rolled steel sheet; prepainted, electrolytically zinc coated, or hot-dip galvanized, G30 coating designation; with prefinished 9/16-inch-wide metal caps on flanges.

1. Structural Classification: Heavy-duty system.
2. End Condition of Cross Runners: Override (stepped) type.
3. Face Design: Flat, tegular flush.
4. Cap Material: Cold-rolled steel.
5. Cap Finish: Painted color indicated on Finish Legend in Drawings.

2.5 ACCESSORIES

A. 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.

B. Wire Hangers, Braces, and Ties: Provide wires as follows:

1. Zinc-Coated, Carbon-Steel Wire: ASTM A641/A641M, Class 1 zinc coating, soft temper.
2. 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.

C. Impact Clips: Manufacturer's standard impact-clip system designed to absorb impact forces against acoustical panels.

D. Seismic Clips: Manufacturer's standard seismic clips designed to secure acoustical panels in place during a seismic event.

E. Seismic Stabilizer Bars: Manufacturer's standard perimeter stabilizers designed to accommodate seismic forces.

F. Seismic Struts: Manufacturer's standard compression struts designed to accommodate seismic forces.

2.6 METAL EDGE MOLDINGS AND TRIM

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Armstrong World Industries, Inc.
2. CertainTeed Corporation.
3. Rockfon (Rockwool International).
4. USG Corporation.

B. Painted color indicated on Finish Legend in Drawings.

C. Roll-Formed, Sheet-Metal Edge Moldings and Trim: Type and profile indicated or, if not indicated, manufacturer's standard moldings for edges and penetrations that comply with seismic design requirements; formed from sheet metal of same material, finish, and color as that used for exposed flanges of suspension-system runners.

1. Edge moldings shall fit acoustical panel edge details and suspension systems indicated and match width and configuration of exposed runners unless otherwise indicated.
2. 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.
3. For circular penetrations of ceiling, provide edge moldings fabricated to diameter required to fit penetration exactly.

2.7 ACOUSTICAL SEALANT

A. Acoustical Sealant: As specified in Section 07 9219 "Acoustical Joint Sealants."

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions, including structural framing to which acoustical panel ceilings attach or abut, with Installer present, for compliance with requirements specified in this and other Sections that affect ceiling installation and anchorage and with requirements for installation tolerances and other conditions affecting performance of acoustical panel ceilings.

B. Examine acoustical panels before installation. Reject acoustical panels that are wet, moisture damaged, or mold damaged.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Measure each ceiling area and establish layout of acoustical panels to balance border widths at opposite edges of each ceiling. Avoid using less-than-half-width panels at borders unless otherwise indicated, and comply with layout shown on reflected ceiling plans.

B. Layout openings for penetrations centered on the penetrating items.

3.3 INSTALLATION

A. Install acoustical panel ceilings according to ASTM C636/C636M, seismic design requirements, and manufacturer's written instructions.

B. Suspend ceiling hangers from building's structural members and as follows:

1. Install hangers plumb and free from contact with insulation or other objects within ceiling plenum that are not part of supporting structure or of ceiling suspension system.
2. Splay hangers only where required to miss obstructions; offset resulting horizontal forces by bracing, 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. 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.
6. Do not attach hangers to steel deck tabs.
7. 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.
8. 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.

D. Install edge moldings and trim of type indicated at perimeter of acoustical ceiling area and where necessary to conceal edges of acoustical panels.

1. Apply acoustical sealant in a continuous ribbon concealed on back of vertical legs of moldings before they are installed.
2. 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.
3. Do not use exposed fasteners, including pop rivets, on moldings and trim.

E. Install suspension-system runners so they are square and securely interlocked with one another. Remove and replace dented, bent, or kinked members.

F. Install acoustical panels with undamaged edges and fit accurately into suspension-system runners and edge moldings. Scribe and cut panels at borders and penetrations to provide precise fit.

1. Arrange directionally patterned acoustical panels as follows:

    a. As indicated on reflected ceiling plans.

2. For square-edged panels, install panels with edges fully hidden from view by flanges of suspension-system runners and moldings.
3. For reveal-edged panels on suspension-system runners, install panels with bottom of reveal in firm contact with top surface of runner flanges.
4. Paint cut edges of panel remaining exposed after installation; match color of exposed panel surfaces using coating recommended in writing for this purpose by acoustical panel manufacturer.
5. Install impact and seismic clips in areas indicated; space according to panel manufacturer's written instructions unless otherwise indicated.
6. Protect lighting fixtures and air ducts according to requirements indicated for fire-resistance-rated assembly.

3.4 ERECTION TOLERANCES

A. Suspended Ceilings: Install main and cross runners level to a tolerance of 1/8 inch in 12 feet, non-cumulative.

B. 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: Engage a qualified special inspector to perform the following special inspections:

1. Periodic inspection during the installation of suspended ceiling grids according to ASCE/SEI 7.

B. Perform the following tests and inspections of completed installations of acoustical panel 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 panels have been installed. Do not proceed with installations of acoustical panel ceiling hangers for the next area until test results for previously completed installations of acoustical panel 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.

C. Acoustical panel ceiling hangers, anchors, and fasteners will be considered defective if they do not pass tests and inspections.

D. Prepare test and inspection reports.

3.6 CLEANING

A. Clean exposed surfaces of acoustical panel ceilings, including trim, edge moldings, and suspension-system members. Comply with manufacturer's written instructions for cleaning and touchup of minor finish damage.

B. Remove and replace ceiling components that cannot be successfully cleaned and repaired to permanently eliminate evidence of damage.

END OF SECTION 09 5113

SECTION 09 5427 - LINEAR WOOD CEILINGS

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes linear wood plank ceilings.

1.2 ACTION SUBMITTALS

A. Product Data: For each product indicated.

B. Shop Drawings: Layout Drawings for architect's review of installation showing quantity, length of panels required and layout.

1. Layout drawing submittal to coordinate Work with that of other trades. Specifically, coordinate with the installer of suspension system to have panel dowels align for intended result and appearance.

C. Coordination Drawings: Drawn to scale and coordinating and showing the following:

1. Linear pattern.
2. Joint pattern.
3. Ceiling suspension members and locations of cliprails.
4. Method of attaching hangers to building structure.
5. Ceiling-mounted items.
6. Ceiling perimeter and penetrations through ceiling.
7. Show locations and sizes of blocking and nailers, including concealed blocking and reinforcement specified in other Sections.

D. Samples for Verification:

1. Provide 12-foot-square Sample of linear wood plank ceiling pattern specified, complete with wood backers and wood with the factory applied finish treatment.

1.3 INFORMATIONAL SUBMITTALS

A. Certification: From panel manufacturer. Written certification, signed by manufacturer, guaranteeing that all furnished products are of specified wood species, dowel treatment, staples, and method of assembly.

1.4 QUALITY ASSURANCE

A. Installer Qualifications: Installer firm with a minimum of 2 years successful experience in installation of suspended wood ceilings of similar requirements to this project. Use installer that is acceptable to architect, manufacturer, and owner's representative.

B. Seismic Performance: Linear wood ceilings designed and installed to withstand the effects of earthquake motions according to the following:

1. Standard for Ceiling Suspension Systems Requiring Seismic Restraint: Comply with ASTM E 580.
2. CISCA's Recommendations for Acoustical Ceilings: Comply with CISCA's "Recommendations for Direct-Hung Acoustical Tile and Lay-in Panel Ceilings—Seismic Zones 0-2."
3. CISCA's Guidelines for Systems Requiring Seismic Restraint: Comply with CISCA's "Guidelines for Seismic Restraint of Direct-Hung Suspended Ceiling Assemblies--Seismic Zones 3 & 4."

C. Mockups: Build mockups to verify selections made under sample Submittals and to demonstrate aesthetic effects and qualities of materials and execution.

1. Approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.5 PRODUCT DELIVERY, STORAGE, AND HANDLING

A. Protect panels during transit, storage and handling to prevent damage, soiling and deterioration.

B. Identify each carton to correlate with architectural reviewed layout drawing using temporary and removable markings.

C. Inspect materials delivered to the jobsite for quality of construction, appearance, and for uncorrectable damage from transit.

1. Notify supplier immediately concerning perceived problems with material. If no notification is given in writing to the Supplier within 15 days after product is shipped, receipt of satisfactory product shall be established.

D. Store materials in original cartons laid flat on a clean, dry, and level surface in an area protected from weather and have a uniform temperature of at least 60 degrees F. Do not stack cartons more than five high.

1.6 PROJECT CONDITIONS

A. Weather Limitations: Proceed with installation only when existing and forecast weather conditions permit work to be performed and at least one coat of specified finish can be applied without exposure to rain, snow, or dampness.

B. Do not install linear wood plank ceilings materials that are wet, moisture damaged, or mold damaged.

1. Indications that materials are wet or moisture damaged include, but are not limited to, discoloration, sagging, or irregular shape.
2. Indications that materials are mold damaged include, but are not limited to, fuzzy or splotchy surface contamination and discoloration.

1.7 COORDINATION OF WORK

A. Coordinate layout and installation of linear wood planks and ceiling suspension system with other work penetrating the wood ceiling, including light fixtures, HVAC equipment, and fire suppression system components.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Fire Performance of Solid Hardwood Planks and Backers: Class C ASTM E84 surface burning characteristics. Flame Spread Index 200 or less. Smoke Developed Index 450or less.

2.2 LINEAR VENEERED PLANKS

A. Product: Subject to compliance with requirements, provide Armstrong World Industries, Inc.; Woodworks Linear Veneered Panels 6691FO1W1.

B. Interior Wood Planks: Solid unperforated fire-rated particleboard core with wood-veneer facing.

1. Wood Plank Species: Plain Slice Walnut.
2. Pattern: As indicated.
3. Plank Dimensions: Nominal 6-inch wide by 3/4-inch planks.
4. Panel Dimensions: 24 inches by 96 inches.
5. Edge Profile: Square.
6. Edgebanding: Match facing.
7. Assembly Style: Grooves in back of planks for integrated factory-applied clips with attach to T-Bar grid.
8. Fabrication: Fabricate wood planks in shop, without finger jointing. Install acoustical backing in field.
9. Finish: Clear satin sheen with UV blocker and matching existing wood paneling on walls.

2.3 SUSPENSION SYSTEMS

A. Suspension Systems Standard: Ceiling manufacturer's standard metal suspension systems of types and finishes indicated that comply with applicable ASTM C 635 requirements.

B. Attachment Devices: Size for 5 times the design load indicated in ASTM C 635, Table 1, Direct Hung, unless otherwise indicated.

1. Backer Clips: 3/8-inch by 11/16-inch by 7/7-inch clips integral with planks and spaced as recommended by manufacturer.

C. Carriers: Factory finished.

1. Metal T-Grid Suspension System: Standard interior heavy-duty 15/16 metal suspension T-grid system, 12 gage hanger wire, concealed T-bar hooks, main runners, cross-tees, wall angle or shadow moldings with black finishes.

D. Angle Wall Molding: 7/8 inch.

E. Carrier Splices: Same metal, profile, and finish as indicated for carriers.

F. Acoustic Backer: BioAcoustic Infill Panel, matte black.

G. Stabilizer Channels, Tees, and Bars: Manufacturer's standard components for stabilizing main carriers; spaced as standard with manufacturer for use indicated; and factory finished with matte-black baked finish.

H. Seismic Struts: Manufacturer's standard.

I. Impact Clips: At interior installations, provide manufacturer's standard impact-clip system designed to absorb impact forces against acoustical panels.

2.4 FABRICATION

A. Wood Moisture Content: 9 to 15 percent.

B. Fabricate wood ceilings to dimensions, profiles, and details indicated. Ease edges to radius indicated for the following:

C. Complete fabrication, including assembly, finishing, and hardware application, to maximum extent possible before shipment to Project site. Disassemble components only as necessary for shipment and installation. Where necessary for fitting at site, provide ample allowance for scribing, trimming, and fitting.

D. Shop cut openings, to maximum extent possible, to receive hardware, electrical work, and similar items. Finish cut ends to match exposed wood face and grille. Locate openings accurately and use templates or roughing-in diagrams to produce accurately sized and shaped openings.

2.5 FINISH

A. Transparent Finish: Comply with requirements indicated below for grade, finish system, and sheen with sheen measured on 60-degree gloss meter per ASTM D 523:

1. Grade: Premium.
2. Factory-finish wood planks with stain as selected by architect and clear varnish as recommended by linear wood ceiling manufacturer that meets Class A fire protection requirements per ASTM E-84.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine surfaces, with Installer present, to determine acceptable conditions affecting the proper installation of materials. Do not proceed until unsatisfactory conditions have been corrected.

B. Do not proceed with installation until unsatisfactory conditions have been corrected. Notify the general contractor immediately if conditions are not satisfactory.

1. Reject panels with defects.

3.2 PREPARATION

A. Before installation, condition wood planks to average prevailing humidity conditions in installation areas. Heating and cooling systems are to be operating before, during, and after installation, with the humidity of the interior spaces maintained between 25 and 55 percent.

B. Prior to the start of interior installations, verify that all exterior windows and doors are in place, glazed, and weather-stripped, roof is watertight, and wet trades' work is complete and thoroughly dry.

C. Verify that mechanical, electrical, and other utility service installations above the ceiling plane have been completed. No materials are to rest against or wrap around the ceiling suspension components or connecting hangers.

D. Measure ceiling areas and establish the layout of hangers and cliprails, in accordance with manufacturer’s installation instructions.

3.3 EXAMINATION

A. Examine substrates, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance.

B. Before installing linear wood plank ceilings, examine shop-fabricated work for completion and complete work as required, including removal of packing and backpriming.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.4 INSTALLATION

A. General: Install wood ceilings to comply with manufacturer's written instructions and in compliance with applicable regulations and industry standards including seismic requirement indicated, per CISCA's "Ceiling Systems Handbook."

B. Scribe and cut woodwork to fit adjoining work, and refinish cut surfaces or repair damaged finish at cuts.

C. Install wood planks level, plumb, true, and straight. Install level and plumb to a tolerance of 1/8 inch in 96 inches.

D. Locate main runners perpendicular to wood direction, spaced 24 inches maximum, on center, ending.

1. Do not support ceilings from or attach hangers to permanent metal forms, steel deck tabs, steel roof decks, ducts, pipes, or conduit.
2. Install suspension system carriers so they are aligned. Remove and replace dented, bent, or kinked members.

E. Suspend Wire Hangers.

1. Install hangers and clip rails plumb and free from contact with insulation or other objects within plenum that are not part of supporting structure or of ceiling suspension system.
2. Splay hangers only where required to miss obstructions; offset resulting horizontal forces by bracing, countersplaying, or other equally effective means.
3. Where width of ducts and other construction within plenum produces hanger spacings that interfere with location of hangers or cliprails at spacings required to support standard suspension system members, install supplemental suspension members and hangers in form of trapezes or equivalent devices. Size supplemental suspension members and hangers to support ceiling loads within performance limits established by referenced standards and publications.
4. Secure wire hangers to ceiling suspension members and to cliprails above with a minimum of three tight turns. Connect hangers directly to structures or to inserts, eye screws, or other devices that are secure and appropriate for substrate and that will not deteriorate or otherwise fail due to age, corrosion, or elevated temperatures.
5. Space hangers not more than 48 inches o.c. along each cliprail member supported directly from hangers, unless otherwise indicated; and provide hangers not more than 8 inches from ends of each member.

F. Linear Wood Plank Ceilings: Install planks with 1/4-inch reveal between planks and at perimeter, openings, and horizontal panel joints unless otherwise recommended by panel manufacturer

1. Install with minimum number of joints possible, using full-length pieces (from maximum length of lumber available) to greatest extent possible. Do not use pieces less than 36 inches long, except where shorter single-length pieces are necessary. Scarf running joints and stagger in adjacent and related members.
2. Install planks with no more variation from a straight line than 1/8 inch in 96 inches.
3. Handle, cut, and fasten wood as per manufacturer’s recommendations.

4. Install planks to comply with manufacturer's written instructions.
5. Seal butt joints at inside and outside corners and at trim locations.
6. Conceal clips to greatest practical extent by placing in grooves as detailed.

G. Finish: Where not finished at factory, apply finish within two weeks of installation.

3.5 ADJUSTING AND CLEANING

A. Repair damaged and defective wood planks to eliminate functional and visual defects; replace woodwork where not possible to repair. Adjust joinery for uniform appearance.

B. Clean wood planks on exposed and semiexposed surfaces. Touch up shop-applied finishes to restore damaged or soiled areas.

3.6 PROTECTION

A. Protect installed products from damage from weather and other causes during construction.

B. Remove and replace wood materials that are wet, moisture damaged, and mold damaged.

1. Indications that materials are wet or moisture damaged include, but are not limited to, discoloration, sagging, or irregular shape.
2. Indications that materials are mold damaged include, but are not limited to, fuzzy or splotchy surface contamination and discoloration.

END OF SECTION 09 5427

SECTION 09 6513 - RESILIENT BASE AND ACCESSORIES

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Thermoplastic-rubber base.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Samples for Verification: For each type of product indicated and for each color, texture, and pattern required in manufacturer's standard-size Samples, but not less than 12 inches long.

C. Product Schedule: For resilient base and accessory products. Use same designations indicated on Drawings.

1.3 MAINTENANCE MATERIAL SUBMITTALS

A. Furnish extra materials, from the same product run, 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 feet for every 500 linear feet or fraction thereof, of each type, color, pattern, and size of resilient product installed.

1.4 QUALITY ASSURANCE

A. Mockups: 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 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.

1.5 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.

1.6 FIELD CONDITIONS

A. 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. 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. Products shall comply with the requirements of the California Department of Public Health's "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers."

2.2 THERMOPLASTIC-RUBBER BASE

A. Basis-of-Design Product: Item B1 (Tarkett; Traditional Wallbase) as indicated on Finish Legend in the Drawings.

1. Subject to compliance with requirements, provide by Tarkett Company or equal product by one of the following.

a. Flexco.
b. Roppe Corporation, USA.
c. VPI Corporation.

B. Product Standard: ASTM F1861, Type TP (rubber, thermoplastic).

1. Group: I (solid, homogeneous).
2. Style and Location:

a. Style B, Cove.

C. Thickness: 0.125 inch.

D. Height: 4 inches.

E. Lengths: Coils in manufacturer's standard length.

F. Outside Corners: Job formed.

G. Inside Corners: Job formed.

H. Colors: Match Architect's sample.

2.3 INSTALLATION MATERIALS

A. Adhesives: Water-resistant type recommended by resilient-product manufacturer for resilient products and substrate conditions indicated.

1. Adhesives shall have a VOC content of 50 g/L or less.

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 according to manufacturer's written instructions to ensure adhesion of resilient products.

B. 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.

C. Immediately before installation, sweep and vacuum clean substrates to be covered by resilient products.

3.3 RESILIENT BASE INSTALLATION

A. Comply with manufacturer's written instructions for installing resilient base.

B. Apply resilient base to walls, columns, pilasters, casework and cabinets in toe spaces, and other permanent fixtures in rooms and areas where base is required.

C. Install resilient base in lengths as long as 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. Where resilient base is installed against vinyl composition floor tile, seal bottom of base against the floor tile with clear sealant.

F. Do not stretch resilient base during installation.

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 CLEANING AND PROTECTION

A. Comply with manufacturer's written instructions for cleaning and protecting resilient products.

B. Perform the following operations immediately after completing resilient-product installation:

1. Remove adhesive and other blemishes from surfaces.

C. Protect resilient products from mars, marks, indentations, and other damage from construction operations and placement of equipment and fixtures during remainder of construction period.

END OF SECTION 09 6513

SECTION 09 6816 – COORDINATION FOR SHEET CARPETING INSTALLATION

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes scheduling of Owner provided carpet work and testing of floors to receive Owner furnished, Owner Installed carpet including preparation and coordination for the following carpet products.

1.2 DELIVERY, STORAGE, AND HANDLING

A. Provide storage space and protection for flooring and installation accessories if materials delivered before Substantial Completion.

1.3 FIELD CONDITIONS

A. Slab Testing Conditions: Bring conditions inside building to levels normal at occupancy of building 24 hours prior to beginning slab testing. Maintain these conditions from beginning of slab testing until completion of tests. These conditions include minimum ambient temperature of 65 deg F, relative humidity between 10 and 65 percent, and minimum concrete slab temperature of 65 deg F.

B. It is anticipated that flooring installation will begin no later than 72 hours after Substantial Completion.

C. Existing Conditions: Moisture content present in concrete slab to receive carpet shall not exceed 65 percent and the pH shall not exceed 9.

PART 2 - PRODUCTS

2.1 CARPET

A. Owner-Provided Products: Carpet Types F1 and F2 as indicated on Finish Legend in Drawings.

PART 3 - EXECUTION

3.1 CLEANING AND PROTECTING

A. Do not allow traffic on newly installed carpet for minimum 24 hours after installation is completed.

1. Do not allow placement of furniture or equipment for minimum 72 hours after installation is completed.
2. Do not allow newly carpeted areas be used for storage of furniture, equipment, or other materials for minimum of 72 hours after installation is completed.
3. Do not cover newly installed carpet with plastic until adhesives have properly cured. (minimum 72 hours).

B. Protect carpet 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 manufacturer and carpet cushion and adhesive manufacturers.

C. At completion of the Work when directed by Owner, remove protective covering. Vacuum clean carpeting and remove soiling to Owner's satisfaction.

D. As directed by Owner’s Project Manager, after 72 hours, adequately cover carpeting and protect against damage until acceptance from Owner. Protect by means of new non-stick, non-staining, ventilating 6 mil minimum thick polyethylene sheet that will allow moisture build-up to escape. Tape all seams. Damaged carpeting will be rejected and shall be replaced at no additional cost to Owner.

END OF SECTION 09 6816

SECTION 09 9113 - EXTERIOR PAINTING

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes surface preparation and the application of paint systems on the following exterior substrates:

1. Steel and iron.
2. Galvanized metal.

B. Related Requirements:

1. Section 05 1200 "Structural Steel Framing" for shop priming of metal substrates.
2. Section 05 5000 "Metal Fabrications" for shop priming metal fabrications.

1.2 DEFINITIONS

A. MPI Gloss Level 5 (semigloss): 35 to 70 units at 60 degrees, according to ASTM D523.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product. Include preparation requirements and application instructions.

1. Include printout of current "MPI Approved Products List" for each product category specified, with the proposed product highlighted.
2. Indicate VOC content.

B. Submitted products must meet or exceed performance levels of basis of design products listed in each category.

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.

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 schedules. Include color designations.

1.4 MAINTENANCE MATERIAL SUBMITTALS

A. Furnish extra materials, from the same product run, that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Paint: 5 percent, but not less than 1 gal. of each material and color applied.

1.5 QUALITY ASSURANCE

A. Mockups: Apply mockups of each paint system indicated and each color and finish selected to verify preliminary selections made under Sample submittals and to demonstrate aesthetic effects and set quality standards for materials and execution.

1. Architect will select one surface to represent surfaces and conditions for application of each paint system.

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 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.

1.6 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.

1.7 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 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Benjamin Moore & Co.
2. PPG Paints.
3. Pratt & Lambert.
4. Sherwin-Williams Company (The).

B. Products: Subject to compliance with requirements, provide one of the products listed in the Exterior Painting Schedule for the paint category indicated.

1. Equivalent Products: Substitutions of comparable products by other manufacturers will be considered if the product complies with specified product requirements and is the same in quality and appearance to the specified product, as judged solely by the Architect.

2.2 PAINT, GENERAL

A. MPI Standards: Products shall comply with MPI standards indicated. Products shall be listed in its "MPI Approved Products Lists" unless indicated otherwise.

1. Substitutions of products not listed on the “MPI Approved Products Lists" may be considered if product data for the product is provided that clearly indicates that the product meets or exceeds all MPI requirements.

B. Material Compatibility:

1. Materials for use within each paint system shall 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, products shall be recommended in writing by topcoat manufacturers for use in paint system and on substrate indicated.

C. VOC Content: For field applications, paints and coatings shall comply with VOC content limits of authorities having jurisdiction and the following VOC content limits:

1. Nonflat Paints and Coatings: 100 g/L.
2. Primers, Sealers, and Undercoaters: 100 g/L.
3. Rust-Preventive Coatings: 250 g/L.

D. Colors: As selected by Architect from manufacturer's full range.

2.3 SOURCE QUALITY CONTROL

A. Testing of Paint Materials: Owner reserves the right to invoke the following procedure:

1. Owner will engage the services of a qualified testing agency to sample paint materials. Contractor will be notified in advance and may be present when samples are taken. If paint materials have already been delivered to Project site, samples may be taken at Project site. Samples will be identified, sealed, and certified by testing agency.
2. Testing agency will perform tests for compliance with product requirements.
3. Owner may direct Contractor to stop applying paints if test results show materials being used do not comply with product requirements. Contractor shall remove noncomplying paint materials from Project site, pay for testing, and repaint surfaces painted with rejected materials. Contractor will be required to remove rejected materials from previously painted surfaces if, on repainting with complying materials, the two paints are incompatible.

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. Verify suitability of substrates, including surface conditions and compatibility, with existing finishes and primers.

C. 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 and recommendations in "MPI Architectural Painting Specification Manual" 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 indicated.

D. Steel Substrates: Remove rust, loose mill scale, and shop primer if any. Clean using methods recommended in writing by paint manufacturer but not less than the following:

1. SSPC-SP 3.

E. 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.

F. Galvanized-Metal Substrates: Remove grease and oil residue from galvanized sheet metal by mechanical methods to produce clean, lightly etched surfaces that promote adhesion of subsequently applied paints.

3.3 APPLICATION

A. Apply paints according to manufacturer's written instructions and recommendations in "MPI Architectural Painting Specification Manual."

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. Do not paint over labels of independent testing agencies or equipment name, identification, performance rating, or nomenclature plates.
5. Primers specified in painting schedules may be omitted on items that are factory primed or factory finished if acceptable to topcoat manufacturers.
6. Do not paint finish copper, bronze, chromium plate, nickel, stainless steel, anodized aluminum, or monel metal except as explicitly indicated or specified.

B. If undercoats or other conditions show through topcoat, apply additional coats until cured film has a uniform paint finish, color, and appearance.

C. 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.

D. 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. Contractor shall 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, Contractor shall pay for testing and apply additional coats as needed to provide dry film thickness that complies with paint manufacturer's written recommendations.

3.5 CLEANING AND PROTECTION

A. At end of each workday, remove rubbish, empty cans, rags, and other discarded materials from Project site.

B. After completing paint application, clean spattered surfaces. Remove spattered paints by washing, scraping, or other methods. Do not scratch or damage adjacent finished surfaces.

C. Protect work of other trades against damage from paint application. Correct damage to work of other trades by cleaning, repairing, replacing, and refinishing, as approved by Architect, and leave in an undamaged condition.

D. At completion of construction activities of other trades, touch up and restore damaged or defaced painted surfaces.

3.6 EXTERIOR PAINTING SCHEDULE

A. Steel and Iron Substrates:

1. Water-Based Light Industrial Coating System MPI EXT 5.1M:

a. Prime Coat: Primer, rust inhibitive, water based.

1) Benjamin Moore: Ultra Spec HP: Acrylic Metal Primer - HP04/FP04.
2) Sherwin-Williams: Pro Industrial: Pro-Cryl Universal Primer - B66W01310.

b. Intermediate Coat: Light industrial coating, exterior, water based, matching topcoat.
c. Topcoat: Light industrial coating, exterior, water based, semi-gloss (MPI Gloss Level 5), MPI #163.

1) Sherwin-Williams: Pro Industrial; DTM Semi-Gloss - B66W01151.

B. Galvanized-Metal Substrates:

1. Water-Based Light Industrial Coating System MPI EXT 5.3J:

a. Prime Coat: Primer, galvanized, water based, MPI #134.

    1) Benjamin Moore: Ultra Spec HP; Acrylic Metal Primer - HP04/FP04.
    2) PPG Architectural: High Performance Coatings; Pitt-Tech Plus 4020 PF / Devflex 4020 PF - 4020 1000.
    3) Pratt & Lambert: Krylon Industrial; Iron Guard White Primer - K000Z6631.
    4) Sherwin-Williams: Pro Industrial; Pro-Cryl Universal Primer - B66W1310.

b. Intermediate Coat: Light industrial coating, exterior, water based, matching topcoat.

c. Topcoat: Light industrial coating, exterior, water based, semi-gloss (MPI Gloss Level 5), MPI #163.

    1) Sherwin-Williams: Pro Industrial; DTM Semi-Gloss - B66W01151.

END OF SECTION 09 9113

SECTION 09 9123 - INTERIOR PAINTING

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes surface preparation and the application of paint systems on the following interior substrates:

1. Steel and iron.
2. Gypsum board walls and ceilings.

B. Related Requirements:

1. Section 05 5000 "Metal Fabrications" for shop priming metal fabrications.
2. Section 09 9600 "High-Performance Coatings" for coatings on exterior steel and galvanized steel.

1.2 DEFINITIONS

A. MPI Gloss Level 1 (flat): Not more than five units at 60 degrees and 10 units at 85 degrees, according to ASTM D523.

B. MPI Gloss Level 4 (satin-like): 20 to 35 units at 60 degrees and not less than 35 units at 85 degrees, according to ASTM D523.

C. MPI Gloss Level 5 (semigloss): 35 to 70 units at 60 degrees, according to ASTM D523.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product. Include preparation requirements and application instructions.

1. Indicate VOC content.

B. Submitted products must meet or exceed performance levels of basis of design products listed in each category.

C. Samples for Verification: For each type of paint system and in each color and gloss of topcoat.

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 schedules. Include color designations.

1.4 MAINTENANCE MATERIAL SUBMITTALS

A. Furnish extra materials, from the same product run, that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Paint: 5 percent, but not less than 1 gal. of each material and color applied.

1.5 QUALITY ASSURANCE

A. Mockups: Apply mockups of each paint system indicated and each color and finish selected to verify preliminary selections made under Sample submittals and to demonstrate aesthetic effects and set quality standards for materials and execution.

1. Architect will select one surface to represent surfaces and conditions for application of each paint system.

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 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.

B. Where conflicting information is found in the Construction Documents related to products, details or dimensional discrepancies, comply with the most stringent requirements regardless of cost.

1.6 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.

1.7 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 less than 5 deg F above the dew point; or to damp or wet surfaces.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Benjamin Moore & Co.
2. PPG Paints.
3. Pratt & Lambert.
4. Sherwin-Williams Company (The).

B. Products: Subject to compliance with requirements, provide one of the products listed in the Interior Painting Schedule for the paint category indicated.

1. Equivalent Products: Substitutions of comparable products by other listed manufacturers will be considered prior to bid if the product complies with specified product requirements and is the same in quality and appearance as the specified product, as judged by the Architect.

2.2 PAINT, GENERAL

A. Material Compatibility:

1. Materials for use within each paint system shall 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, products shall be recommended in writing by topcoat manufacturers for use in paint system and on substrate indicated.

B. VOC Content: For field applications that are inside the weatherproofing system, paints and coatings shall comply with VOC content limits of authorities having jurisdiction and the following VOC content limits:

1. Flat Paints and Coatings: 50 g/L.
2. Nonflat Paints and Coatings: 100 g/L.
3. Primers, Sealers, and Undercoaters: 100 g/L.
4. Rust-Preventive Coatings: 250 g/L.
5. Zinc-Rich Industrial Maintenance Primers: 340 g/L.

C. Colors: As indicated, or if not indicated, as selected by Architect from manufacturer's full range.

D. Testing of Paint Materials: Owner reserves the right to invoke the following procedure:

1. Owner will engage the services of a qualified testing agency to sample paint materials. Contractor will be notified in advance and may be present when samples are taken. If paint materials have already been delivered to Project site, samples may be taken at Project site. Samples will be identified, sealed, and certified by testing agency.
2. Testing agency will perform tests for compliance with product requirements.
3. Owner may direct Contractor to stop applying paints if test results show materials being used do not comply with product requirements. Contractor shall remove noncomplying paint materials from Project site, pay for testing, and repaint surfaces painted with rejected materials. Contractor will be required to remove rejected materials from previously painted surfaces if, on repainting with complying materials, the two paints are incompatible.

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. Gypsum Board: 12 percent.

C. Gypsum Board Substrates: Verify that finishing compound is sanded smooth.

D. Verify suitability of substrates, including surface conditions and compatibility, with existing finishes and primers.

E. 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 and recommendations in "MPI Architectural Painting Specification Manual" 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. Steel Substrates: Remove rust, loose mill scale, and shop primer, if any. Clean using methods recommended in writing by paint manufacturer but not less than the following:

1. SSPC-SP 3.

E. 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.

F. Galvanized-Metal Substrates: Remove grease and oil residue from galvanized sheet metal by mechanical methods to produce clean, lightly etched surfaces that promote adhesion of subsequently applied paints.

3.3 APPLICATION

A. Apply paints according to manufacturer's written instructions and to recommendations in "MPI Manual."

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. Do not paint over labels of independent testing agencies or equipment name, identification, performance rating, or nomenclature plates.
5. Primers specified in painting schedules may be omitted on items that are factory primed or factory finished if acceptable to topcoat manufacturers.
6. Do not paint finish copper, bronze, chromium plate, nickel, stainless steel, anodized aluminum, or monel metal except as explicitly indicated or specified.

B. If undercoats or other conditions show through topcoat, apply additional coats until cured film has a uniform paint finish, color, and appearance.

C. 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.

1. Painted Wall and Ceiling Texture: Apply paint on walls and ceilings to achieve light to medium orange peel texture.

D. Painting Fire Suppression, Plumbing, HVAC, Electrical, Communication, and Electronic Safety and Security Work:

1. Paint the following work where exposed in equipment rooms:

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.
h. Duct, equipment, and pipe insulation having cotton or canvas insulation covering or other paintable jacket material.

2. Paint the following work where exposed 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. Contractor shall 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, Contractor shall pay for testing and apply additional coats as needed to provide dry film thickness that complies with paint manufacturer's written recommendations.

3.5 CLEANING AND PROTECTION

A. At end of each workday, remove rubbish, empty cans, rags, and other discarded materials from Project site.

B. After completing paint application, clean spattered surfaces. Remove spattered paints by washing, scraping, or other methods. Do not scratch or damage adjacent finished surfaces.

C. Protect work of other trades against damage from paint application. Correct damage to work of other trades by cleaning, repairing, replacing, and refinishing, as approved by Architect, and leave in an undamaged condition.

D. At completion of construction activities of other trades, touch up and restore damaged or defaced painted surfaces.

3.6 INTERIOR PAINTING SCHEDULE

A. Provide Basis of Design Products indicated below, or equivalent approved by Architect.

B. Steel Substrates:

1. Water-Based Light Industrial Coating System:

a. Prime Coat: Primer, rust-inhibitive, water based.

1) Sherwin-Williams: Pro Industrial: Pro-Cryl Universal Primer - B66W01310.

b. Intermediate Coat: Light industrial coating, interior, water based, matching topcoat.

c. Topcoat: Light industrial coating, interior, water based, semi-gloss (MPI Gloss Level 5).

1) Sherwin-Williams: Pro Industrial; DTM Acrylic Semi-Gloss- B66W011511.

C. Gypsum Board Substrates: Ceilings:

1. Latex System:

a. Prime Coat: Primer, latex, for interior gypsum board.

1) Sherwin-Williams: Interior Latex Primer – B28W08111.

b. Intermediate Coat: Latex, interior, high performance architectural, matching topcoat.

c. Topcoat at Walls and Ceilings in Typical Living Areas: Latex, interior, flat (MPI Gloss Level 1).

1) Sherwin-Williams: Duration; Interior Latex Semi-Gloss-A98W01251.
2) Color: C1 as indicated on Finish Legend.
3) Texture: Light orange peel texture.

D. Gypsum Board Substrates: Walls.

1. Latex System:

a. Prime Coat: Primer, latex, for interior gypsum board.

1) Sherwin-Williams: Interior Latex Primer – B28W08111.

b. Intermediate Coat: Latex, interior, high performance architectural, matching topcoat.

c. Topcoat at Walls and Ceilings in Kitchens and Bathrooms: Latex, interior, satin (MPI Gloss Level 4).

1) Sherwin-Williams: Optimus; Interior-Exterior Latex Semi-Gloss-Enamel - A98W01251.
2) Colors: Item W1, W2, W3, W4, and W5, as indicated on Finish Legend.
3) Texture: Light orange peel texture.

END OF SECTION 09 9123

SECTION 09 9600 - HIGH-PERFORMANCE COATINGS

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes surface preparation and the application of high-performance coating systems on the following substrates:

1. Exterior Substrates:

a. Steel bollards.

B. Related Requirements:

1. Section 09 9123 "Interior Painting" for general field painting.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product. Include preparation requirements and application instructions.

1. Indicate VOC content.

B. Submitted products must meet or exceed performance levels of basis of design products listed in each category.

C. Shop-Applied Primer Verification for Steel: Provide written verification that shop surface preparation and specified shop primer was applied as specified in this Section or in the steel specification sections.

D. Samples for Initial Selection: For each type of topcoat product indicated.

E. Samples for Verification: For each type of coating system and each color and gloss of topcoat indicated.

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.

F. Product List: Cross-reference to coating system and locations of application areas. Use same designations indicated on Drawings and in schedules. Include color designations.

1.3 MAINTENANCE MATERIAL SUBMITTALS

A. Furnish extra materials, from the same product run, that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Coatings: 5 percent, but not less than 1 gal. of each material and color applied.

1.4 QUALITY ASSURANCE

A. Mockups: Apply mockups of each coating system indicated to verify preliminary selections made under Sample submittals and to demonstrate aesthetic effects and set quality standards for materials and execution.

1. Architect will select one surface to represent surfaces and conditions for application of each coating system.

a. 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 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.

1.5 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 coatings only when temperature of surfaces to be coated and ambient air temperatures are between 50 and 95 deg F.

B. Do not apply coatings when relative humidity exceeds 85 percent; at temperatures less than 5 deg F above the dew point; or to damp or wet surfaces.

C. Do not apply exterior coatings in snow, rain, fog, or mist.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Benjamin Moore & Co.
2. PPG Paints.
3. Sherwin-Williams Company (The).
4. Tnemec Inc.
5. Other manufacturers as scheduled.

B. Products: Subject to compliance with requirements, provide one of the products listed in the Exterior High-Performance Coating Schedule or Interior High-Performance Coating Schedule for the coating category indicated.

1. Equivalent Products: Substitutions of comparable products by other manufacturers will be considered if the product complies with specified product requirements and is the same in quality and appearance to the specified product, as judged by the Architect.

2.2 HIGH-PERFORMANCE COATINGS, GENERAL

A. Material Compatibility:

1. Materials for use within each paint system shall 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, products shall be recommended in writing by topcoat manufacturers for use in paint system and on substrate indicated.
3. Products shall be of same manufacturer for each coat in a coating system.

B. VOC Content: For field applications, paints and coatings shall comply with VOC content limits of authorities having jurisdiction and the following VOC content limits:

1. Flat Paints and Coatings: 50 g/L.
2. Nonflat Paints and Coatings: 100 g/L.
3. Primers, Sealers, and Undercoaters: 100 g/L.
4. Rust-Preventive Coatings: 250 g/L.
5. Zinc-Rich Industrial Maintenance Primers: 340 g/L.

C. Colors: As selected by Architect from manufacturer's full range.

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. Verify suitability of substrates, including surface conditions and compatibility, with existing finishes and primers.

C. 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 and recommendations in "MPI Architectural Painting Specification Manual" applicable to substrates and coating 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 coatings, 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 coating systems indicated.

D. Steel Substrates: Remove rust, loose mill scale, and shop primer if any. Clean using methods recommended in writing by paint manufacturer but not less than the following:

1. SSPC-SP 6/NACE No. 3.

E. 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.

3.3 APPLICATION

A. Apply high-performance coatings according to manufacturer's written instructions and recommendations in "MPI Architectural Painting Specification Manual."

1. Use applicators and techniques suited for coating and substrate indicated.

2. Coat surfaces behind movable equipment and furniture same as similar exposed surfaces. Before final installation, coat surfaces behind permanently fixed equipment or furniture with prime coat only.
3. Coat backsides of access panels, removable or hinged covers, and similar hinged items to match exposed surfaces.
4. Do not apply coatings over labels of independent testing agencies or equipment name, identification, performance rating, or nomenclature plates.

B. If undercoats or other conditions show through final coat, apply additional coats until cured film has a uniform coating finish, color, and appearance.

C. Apply coatings to produce surface films without cloudiness, spotting, holidays, laps, brush marks, runs, sags, ropiness, or other surface imperfections. Produce sharp glass lines and color breaks.

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 coatings for dry film thickness.

1. Contractor shall touch up and restore coated surfaces damaged by testing.
2. If test results show that dry film thickness of applied coating does not comply with coating manufacturer's written recommendations, Contractor shall pay for testing and apply additional coats as needed to provide dry film thickness that complies with coating manufacturer's written recommendations.

3.5 CLEANING AND PROTECTION

A. At end of each workday, remove rubbish, empty cans, rags, and other discarded materials from Project site.

B. After completing coating application, clean spattered surfaces. Remove spattered coatings by washing, scraping, or other methods. Do not scratch or damage adjacent finished surfaces.

C. Protect work of other trades against damage from coating operation. Correct damage to work of other trades by cleaning, repairing, replacing, and recoating, as approved by Architect, and leave in an undamaged condition.

D. At completion of construction activities of other trades, touch up and restore damaged or defaced coated surfaces.

3.6 EXTERIOR HIGH-PERFORMANCE COATING SCHEDULE

A. Steel Substrates: Urethane and Pigmented Thermoset Fluoropolymer System

1. Shop Surface Preparation: SSPC-SP6/NACE 3 Commercial Blast Cleaning with a minimum angular anchor profile of 1.5 mils.

2. Factory-Applied Prime Coat: Zinc-rich aromatic urethane primer.

    a. Tnemec: Tnemec Series 90-97 Tneme-Zinc applied at 2.5 to 3.5 mils DFT.

3. Field Surface Preparation: Where stripe coating, intermediate coating and finish topcoats are applied in the field, comply with the following:

    a. SSPC-SP11 Power tool cleaning to bare metal.
    b. Touch-up Primer Coat: Aromatic polyurethane, mio-zinc filled primer.

        1) Tnemec: Tnemec Series 394 PerimePrime applied at 2.5 to 3.5 mils DFT.

4. Stripe Coat: As per SSPC-PA11, polyamidoamine epoxy to coat welds, edges, bolt holes, etc.

    a. Tnemec: Tnemec Series V69 Hi-Build Epoxoline II.

5. Intermediate Coat: Polyamidoamine epoxy.

    a. Tnemec: Tnemec Series V69 Hi-Build Epoxoline II applied at 3 to 5 mils DFT.

6. Finish Topcoat: Advanced thermoset solution fluoropolymer, pigmented, semi-gloss.

    a. Tnemec: Tnemec Series 1071V Fluoronar applied at 2 to 3 mils DFT.

END OF SECTION 09 9600

SECTION 10 1100 - VISUAL DISPLAY UNITS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Floor-to-ceiling visual display assemblies.

1.2 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1.3 ACTION SUBMITTALS

A. Product Data:

1. Floor-to-ceiling visual display assemblies.

B. Product Data Submittals: For each product.

1. Include construction details, material descriptions, dimensions of individual components and profiles, finishes, and accessories for visual display units.

C. Shop Drawings: For visual display units.

1. Include plans, elevations, sections, details, and attachment to other work.
2. Show locations of panel joints. Show locations of field-assembled joints for factory-fabricated units too large to ship in one piece.

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.

E. Product Schedule: For visual display units.

1.4 INFORMATIONAL SUBMITTALS

A. Qualification Data: For Installer.

B. Product Test Reports: For each visual display unit, for tests performed by a qualified testing agency.

C. Sample Warranties: For manufacturer's special warranties.

1.5 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For visual display units to include in maintenance manuals.

1.6 QUALITY ASSURANCE

A. Installer Qualifications: An entity that employs installers and supervisors who are trained and approved by manufacturer.

B. Mockups: Build mockups to verify selections made under Sample submittals, to demonstrate aesthetic effects, and to set quality standards for fabrication and installation.

1. Build mockup of typical floor-to-ceiling visual display assembly as shown on Drawings. Include accessories.
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. 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: Do not deliver or install visual display units until spaces are enclosed and weathertight, wet-work in spaces is complete and dry, work above ceilings is complete, and temporary HVAC system is operating and maintaining ambient temperature and humidity conditions at occupancy levels during the remainder of the construction period.

1.9 WARRANTY

A. Special Warranty for Porcelain-Enamel Face Sheets: Manufacturer agrees to repair or replace porcelain-enamel face 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. Life of the building.

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 FLOOR-TO-CEILING VISUAL DISPLAY ASSEMBLIES

A. Products: Subject to compliance with requirements, provide one of the following:

1. Platinum Visual Solutions; FCS Series Wall to Wall Markerboards with Writanium steel face.

B. Floor-to-Ceiling Markerboard Panel Assemblies: Consisting of markerboard panels with porcelain-enamel facing on core indicated; fabricated for floor-to-ceiling assemblies.

1. Color: As selected by Architect from full range of industry colors.

C. Width: As indicated on Drawings.

D. Height: Full height of wall, as indicated on Drawings.

E. Joint Accessories: Manufacturer's standard, concealed aluminum or steel spline at butt joints.

2.3 MARKERBOARD PANELS

A. Porcelain-Enamel Markerboard Panels: Balanced, high-pressure, factory-laminated markerboard assembly of three-ply construction, consisting of moisture-barrier backing, core material, and porcelain-enamel face sheet with low-gloss finish. Laminate panels under heat and pressure with manufacturer's standard, flexible waterproof adhesive.

1. Face Sheet Thickness: 0.0149 inch (28 gauge) uncoated base metal thickness.
2. Particleboard Core: 1/2 inch thick; with 0.005-inch-thick, aluminum foil backing.
3. Laminating Adhesive: Manufacturer's standard moisture-resistant thermoplastic type.

2.4 MATERIALS

A. Porcelain-Enamel Face Sheet: PEI-1002, with face sheet manufacturer's standard two- or three-coat process.

B. Particleboard: ANSI A208.1, Grade M-1.

C. 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.

1. Verify adhesives have a VOC content of 50 g/L or less.

D. Primer/Sealer: Mildew-resistant primer/sealer complying with requirements in Section 09 9123 "Interior Painting" and recommended in writing by visual display unit manufacturer for intended substrate.

2.5 GENERAL FINISH REQUIREMENTS

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.

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 walls and partitions for proper preparation and backing for visual display units.

C. 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 direct-applied, floor-to-ceiling visual display assemblies and as recommended in writing by primer/sealer manufacturer and visual display unit manufacturer.

3.3 INSTALLATION

A. General: 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.

B. Field-Assembled Visual Display Board Assemblies: Coordinate field-assembled units with grounds, 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. 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.

C. Floor-to-Ceiling Markerboard Panels: Attach panels to wall surface with egg-size adhesive gobs at 16 inches o.c., horizontally and vertically.

1. Join adjacent panels with exposed, H-shaped aluminum trim painted to match wall panel.

3.4 CLEANING AND PROTECTION

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.

C. Cover and protect visual display units after installation and cleaning.

END OF SECTION 10 1100

SECTION 10 1400 - SIGNAGE

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Interior directional and informational signs.
2. Building identification signs.
3. Traffic signs.

B. Reference Standards:

1. ADA Standards - 2010 ADA Standards for Accessible Design 2010.
2. ICC A117.1 - Accessible and Usable Buildings and Facilities 2017.

1.2 SUBMITTALS

A. Product Data: Manufacturer's printed product literature for each type of sign, indicating sign styles, font, foreground and background colors, locations, overall dimensions of each sign.

B. Signage Schedule: Provide information sufficient to completely define each sign for fabrication, including room number, room name, other text to be applied, sign and letter sizes, fonts, and colors.

1. When room numbers to appear on signs differ from those on drawings, include the drawing room number on schedule.
2. When content of signs is indicated to be determined later, request such information from Owner through Architect at least 2 months prior to start of fabrication; upon request, submit preliminary schedule.
3. Submit for approval by Owner through Architect prior to fabrication.

C. Manufacturer's Installation Instructions: Include installation templates and attachment devices.

1.3 QUALITY ASSURANCE

A. Regulatory Agency Sustainability Approvals:

1. Sign shall meet ANSI A117.1 accessibility code and ADA standards for accessible design and local and state authorities having jurisdiction (AHJ) requirements.

1.4 DELIVERY, STORAGE, AND HANDLING

A. Package signs as required to prevent damage before installation.

B. Package room and door signs in sequential order of installation, labeled by floor or building.

C. Store tape adhesive at normal room temperature.

1.5 FIELD CONDITIONS

A. Do not install tape adhesive when ambient temperature is lower than recommended by manufacturer.

B. Maintain this minimum temperature during and after installation of signs.

PART 2 - PRODUCTS

2.1 SIGNAGE APPLICATIONS

A. Engraved Stone Panel Signage:

1. Fabricators:
   a. Approved Sign Fabricators. See Section 01 6000:
      1) Hans Monument Co, Salt Lake City, UT www.hansmonuments.com.
         (a) Contact Information: Debbie Christensen (801) 484-1594 or fax (801) 467-8308.
      2) Mark H. Bott Co., Ogden, UT www.markbottco.com.
         (a) Contact Information: David E. Bott (801) 393-8087 or fax (801) 393-8080.
2. Stone:
   a. Description:
      (a) Stone building sign(s).
   b. Design Criteria:
      1) Texture and color variation shall be within limits established by Architect's approved sample.
      2) Monument quality, free of defects that would materially impair strength, durability, and appearance.
   c. Dimensions:
      1) Meetinghouse building sign with Church logo and visitors welcome:

(a) Approved sign dimension: 34-1/4 inches (870 mm) high by 55-5/8 inches (1 413 mm) wide by 1-1/4 inch (32 mm) thick as shown on Contract Drawings.

2) Stone building address sign:

(a) Approved sign dimension: 10-1/4 inches (260 mm) high by 15-5/8 inches (397 mm) wide (width may vary in dimension per numerals used in address) by 1-1/4 inch (32 mm) thick as shown on Contract Drawings. Contractor to provide correct address and provide SUBMITTAL with correct numerals to Sign Fabricator.

d. Approved Stone Type. See Section 01 6200:

1) Bethel White Granite.
2) Elberton Sunset Granite.
3) Morning Rose Granite.
4) Medium Barre Granite.

3. Finish: Low pressure, 30 lb (13.6 kg), steeled finish on 80 grit honed surface.
4. Fasteners and Anchors:

a. Provided by Sign Fabricator for method shown on Contract Documents:

1) 'J' bolt system for mounting sign recessed in masonry veneer on framing or CMU.
2) 'Z' bracket system for surface mounting sign on concrete or existing masonry.

5. Submittals:

a. Action Submittals:

1) Shop Drawings:

(a) Show details of attachment system.

2) Samples:

(a) Submit stone sample of approved stone type specified by Architect.

b. Informational Submittals:

1) Approved Stone Type:

(a) Notify Sign Fabricator of approved stone ten (10) week minimum before installation of sign(s).

2) Stone building address sign:

(a) Notify Sign Fabricator of correct address that will be used in address ten (10) week minimum before installation of sign.

6. Delivery, Storage, and Handling

a. Delivery And Acceptance Requirements:

1) Sign Fabricator Responsibility:

(a) Deliver material to site, carefully unload, and check in such manner as to avoid soiling, damaging, or chipping.
(b) Protect material from damage while in transit to job site.

b. Storage And Handling Requirements:

1) General Contractor Responsibility:

(a) Store material on planks clear of ground.
(b) Protect material from damage, dirt, or disfigurement until installation.

7. Installation:

a. General:

1) Set stone sign using mechanical fasteners provided by Sign Fabricator.
2) Joints shall be 3/8 inch (9.5 mm) wide. Use plastic spacers in wall joints.

b. Stone Damage:

1) Installer responsible for repair of damaged surface during installation

8. Cleaning:

a. General:

1) After stone sign installation is completed, clean using non-metallic fiber brushes and clean water.

9. Protection:

a. General Contractor Responsibility:

1) Provide protection for stone sign(s) from masonry cleaning chemicals and other damaging materials until Substantial Completion.

B. Traffic Signage:

1. Permanently Mounted:

a. Post Foundation Concrete: One cu ft cement, 2 cu ft (0.0566 cu m) sand, 4 cu ft (0.1132 cu m) gravel, and 5 gallons (18.93 liters) minimum to 6 gallons (22.71 liters) maximum of water.
b. Post Setting Grout at Sleeves:

1) Acceptable Products:

(a) Normal Construction Grout A by Bonsal American, Charlotte, NC www.bonsal.com.
(b) Advantage 1107 Grout by Dayton Superior Specialty Chemicals, Kansas City, KS www.daytonsuperiorchemical.com.
(c) NS Grout by Euclid Chemical Co, Cleveland, OH www.euclidchemical.com 4) 5 Star Special Grout 110 by Five Star Products Inc, Fairfield, CT www.fivestarproducts.com.
(d) Duragrout by L&M Construction Chemicals Inc, Omaha, NE www.lmcc.com 6) Sonneborn / BASF Building Systems, Shakopee, MN www.chemrex.com.
(e) Tamms Grout 621 by TAMMS Industries, Mentor, OH www.tamms.com.
(f) U S Spec MP Grout by U S Mix Products Co www.usspec.com.
(g) CG-86 Grout by W R Meadows, Hampshire, IL www.wrmeadows.com.
(h) Equal as approved by Architect before use. See Section 01 6000.

c. Accessible Parking Signs:

1) Design Criteria:

(a) Meet regulatory agency requirements for accessibility.
(b) Sign graphics and lettering shall be minimum required by agency having jurisdiction:

(1) International symbol of accessibility should be posted on all accessible parking spaces.
(2) Letters must contain visual characters and high dark to light contrast between characters and background as per ADA requirements:
(3) Provide reflective background.
(4) Van-accessible parking spaces to have additional ‘text’ or ‘sign’ below the accessibility symbol to mark the van-accessible area specifically.

(c) Size: 12 inches (305 mm) x 18 inches (457 mm) aluminum sign.
(d) Sign shall have rounded corners.

2) Acceptable Products:

(a) Parking signs by My Parking Sign, Brooklyn, NY www.MyParkingSign.com.
(b) Equal as approved by Architect before use. See Section 01 6000.

d. Posts:

1) Handicap Accessible Parking Signage:

(a) Provide galvanized post as shown on Contract Drawings.

e. Mounting Sleeves: Nominal 2-1/4 inch 56 mm outside diameter pipe, or 2-1/4 inch (57 mm) square 12 ga Quik-Punch, 30 inches (762 mm) long.

2. Installation:

a. Permanently Mounted:

1) Locate as shown on Site Plan.

(a) Follow ADA guidelines and local and state authorities having jurisdiction (AHJ) for placement of sign requirements:

(1) Van accessible sign should be placed so that it is not obscured by anything including a standing van, vehicle or other obtrusive objects.
(2) Signs should be placed at such a height (at least 60 inches (1 500 mm) above surface) that they do not get obscured by any parked vehicles or other obstructions. Signs must be viewable from drivers' seat of vehicle and located right in view of parking spaces.

2) Install signs square and plumb.
3) Post Foundations:

(a) Follow requirements of Section 03 3000: 'Miscellaneous Exterior Cast-In-Place Concrete' for post foundation:
(b) Mix concrete components thoroughly, place in post foundation holes sized as shown on Contract Drawings.
(c) Mow Strips.

(1) At mow strips where shown on Site Plan, set top of post foundation below grade sufficient to allow for placing of mow strip.

(d) Placement Before Installation of Slabs:

(1) Measure post foundation depth from top of slab. Extend bottom of slab footing sufficient to allow specified amount of concrete around post.

(e) Placement After Installation of Slabs:

(1) Where posts are installed after installation of slabs, core slab width of foundation diameter as shown on Contract Documents to accommodate post foundation.

4) Handicap Accessible Parking Signage:

(a) Attach sign to galvanized steel posts as shown on Contract Drawings with stainless steel self tapping screws.
(b) Isolate dissimilar materials (steel tube and aluminum sign).
(c) For installation on retaining walls, cast sleeves into retaining wall. Sleeves shall extend 2 inches (50 mm) maximum above top of finish concrete elevation.

C. Owner Furnished Miscellaneous Interior Signage.

1. Approved Distributors. See Section 01 6000:

a. Standard Interior Signs:

1) Visual Identity Office:

(a) Contact Information:
(b) 50 E. North Temple St. Rm. 2350, Salt Lake City, UT 84150-3232.
(c) Phone: 1-801-240-1302.
(d) Fax: 1-801-240-5997.
(e) vidoffice@churchofjesuschrist.org.

2) Room Signs: Molded clear acrylic sub-surface graphics sign with set-screw to attach to included mounting bracket.
3) Provide tactile / braille features in signage.
4) Cabinet Door Signs: Flat clear acrylic sub-surface graphics sign with mounting adhesive in position.
5) Color:

(a) Background: Blue.
(b) Lettering: White.

2. Install interior signs square and plumb:

a. Room Signs:

1) Install bracket using two screws. Use proper anchor for substrate.
2) Attach sign to bracket using set-screw.
3) Mount signs as described in Contract Drawings.

b. Cabinet Signs:

1) Remove adhesive protective layer.
2) Position sign correctly and apply to door.
3) Roll sign to secure to door, taking care not to damage sign.

4) Mount signs as described in Contract Drawings.

D. Rest Room Doors Signs:

1. One sign for each designated Rest Room door indicating gender of users.
2. Quality Standard. See Section 01 6200.

a. No. 231595 California Title 24 signs by Best Sign Systems Inc, Montrose, CO www.bestsigns.com.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verify that substrate surfaces are ready to receive work.

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

3.2 INSTALLATION

A. Install in accordance with manufacturer's instructions.

B. Install neatly, with horizontal edges level.

C. Locate signs and mount at heights indicated on drawings and in accordance with ADA Standards and ICC A117.1.

D. Protect from damage until Date of Substantial Completion; repair or replace damaged items.

END OF SECTION 10 1400

SECTION 10 2238 – VERTICAL-RISING OPERABLE PANEL PARTITIONS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Electrically operated, vertical-rising acoustical panel partitions.

B. Related Requirements:

1. Section 05 5000 "Metal Fabrications" for supports that attach supporting tracks to overhead structural system.
2. Electrical and communications Sections for electrical service and connections for motor operators, controls, and limit switches and for system disconnect switches.

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. Shop Drawings: For operable panel partitions.

1. Include plans, elevations, sections, details, and attachments to other work.
2. Indicate stacking and operating clearances. Indicate location and installation requirements for hardware and track, blocking, and direction of travel.
3. Include diagrams for power, signal, and control wiring.

C. Samples for Initial Selection: For each type of exposed material, finish, covering, or facing.

1. Include Samples of accessories involving color selection.

D. Samples for Verification: For each type of exposed material, finish, covering, or facing, prepared on Samples of size indicated below:

1. Panel Facing Material: Manufacturer's standard-size unit, not less than 3 inches square.
2. Panel Edge Material: Not less than 3 inches long.
3. Hardware: One of each exposed door-operating device.

E. Delegated-Design Submittal: For operable panel partitions.

1. Include design calculations for seismic restraints.

1.4 INFORMATIONAL SUBMITTALS

A. Coordination Drawings: Reflected ceiling plans, drawn to scale, on which the following items are shown and coordinated with each other, using input from installers of the items involved:

1. Partition track, track supports and bracing, switches, turning space, and storage layout.
2. Suspended ceiling components.
3. Structural members to which suspension systems are attached.
4. Size and location of initial access modules for acoustical tile.
5. Items penetrating finished ceiling, including the following:

    a. Lighting fixtures.
    b. HVAC ductwork, outlets, and inlets.
    c. Speakers.
    d. Sprinklers.
    e. Smoke detectors.
    f. Access panels.

B. Setting Drawings: For embedded items and cutouts required in other work, including support-beam, mounting-hole template.

C. Qualification Data: For qualified Installer, testing agency, and manufacturer.

D. Seismic Qualification Certificates: For operable panel partitions, tracks, accessories, and components, from manufacturer. Include seismic capacity of partition assemblies to remain in vertical position during a seismic event and the following:

1. Basis for Certification: Indicate whether certification is based on analysis, testing, or experience data, according to ASCE/SEI 7.
2. Detailed description of partition anchorage devices on which the certification is based and their installation requirements.

E. Product Certificates: For each type of operable panel partition.

1. Include approval letter signed by manufacturer acknowledging Owner-furnished panel facing material complies with requirements.

F. Product Test Reports: For each operable panel partition, for tests performed by a qualified testing agency.

G. Field quality-control reports.

H. Sample Warranty: For manufacturer's special warranty.

1.5 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For operable panel partitions to include in maintenance manuals.

1. In addition to items specified in Section 017823 "Operation and Maintenance Data," include the following:

    a. Panel finish facings and finishes for exposed trim and accessories. Include precautions for cleaning materials and methods that could be detrimental to finishes and performance.
    b. Seals, hardware, track, track switches, carriers, and other operating components.
    c. Electric operator and controls.

1.6 MAINTENANCE MATERIAL SUBMITTALS

A. 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. Panel Finish-Facing Material: Furnish full width in quantity to cover both sides of two panels when installed.

1.7 QUALITY ASSURANCE

A. Installer Qualifications: An entity that employs installers and supervisors who are trained and approved by manufacturer.

1.8 DELIVERY, STORAGE, AND HANDLING

A. Protectively package and sequence panels in order for installation. Clearly mark packages and panels with numbering system used on Shop Drawings. Do not use permanent markings on panels.

1.9 WARRANTY

A. Special Warranty: Manufacturer agrees to repair or replace components of operable panel partitions that fail in materials or workmanship within specified warranty period.

1. Failures include, but are not limited to, the following:

    a. Faulty operation of operable panel partitions.
    b. Deterioration of metals, metal finishes, and other materials beyond normal use.

2. Warranty Period: Two years from date of from date of shipment or 5000-cycle.

B. Extended Parts Warranty: Manufacturer agrees to provide replacement parts, excluding touchscreen stations.

1. Warranty Period: Ten years from date of shipment.

C. Acoustical Performance Warranty: Manufacturer agrees to provide replacement parts.

1. Warranty Period: Ten years from date of shipment or 5000-cycle.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Delegated Design: Engage a qualified professional engineer, as defined in Section 014000 "Quality Requirements," to design seismic bracing of tracks to structure above.

B. Seismic Performance: Operable panel partitions shall withstand the effects of earthquake motions determined according to ASCE/SEI 7.

1. The term "withstand" means "the partition panels will remain in place without separation of any parts from the system when subjected to the seismic forces specified."

C. Acoustical Performance: Provide operable panel partitions tested by a qualified testing agency for the following acoustical properties according to test methods indicated:

1. Sound-Transmission Requirements: Operable panel partition assembly tested for laboratory sound-transmission loss performance according to ASTM E 90, determined by ASTM E 413, and rated for not less than the STC indicated.

D. Fire-Test-Response Characteristics: Provide panels with finishes complying with one of the following as determined by testing identical products by UL or another testing and inspecting agency acceptable to authorities having jurisdiction:

1. Surface-Burning Characteristics: Comply with ASTM E 84 or UL 723; 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. Fire Growth Contribution: Complying with acceptance criteria of local code and authorities having jurisdiction when tested according to NFPA 286.

E. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

2.2 VERTICAL-RISING OPERABLE ACOUSTICAL PANELS

A. Operable Acoustical Panels: Partition system, including panels, seals, finish facing, suspension system, operators, and accessories.

B. Basis-of-Design Product: Skyfold dormakaba group; Skyfold Zenith™ 48 Automatic Vertically Retractable Acoustic Walls.

1. STC Rating for System: 48.
2. STC Rating for Panels: 57.

C. Operation Cycles: Raising partition components and operators capable of operating for not less than 10,000. 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.

2.3 VERTICAL-RISING PANELS

A. Construction: Hinged, vertical folding frame supporting rectangular grid acoustical core sections, supported by overhead automatic suspension system, designed for automatic vertical accordion-like extension and retraction, and reinforced for hardware attachment. Securely attach sound-insulating core and facing to frame. Fabricate partitions hard, flat, rigid; level; plumb; aligned, with tight joints and uniform appearance; and free of deformation and surface and finish irregularities.

1. Provide assembly with no exposed hinges, brackets, screws, and with no visible parts of the mechanical system when in the down position and that stacks completely into the indicated pocket space when in up position.
2. Provide rectangular acoustical panels that are individually removable without special tools and that will not dislocate adjacent panels upon removal.
3. Panel Thickness: 11-34 inches.
4. Panel Weight: 6 lbs. per square foot.

B. Provide operable vertical folding partition assembly that automatically acoustically seals against ceiling, floor and end walls when in the down position and provides STC rating indicated. Comply with the following tolerances and gap widths.

1. Gap Between Partition and End Walls While in Motion: 1 inch.
2. Maximum Gap Width Between Partition and Ceiling System: 2 inches.
3. Maximum Gap Width Between Bottom of Partition and Floor: 2 inches.
4. Vertical and Horizontal Joints Between Panel: 1/2-inch wide nominal.

C. Dimensions: Fabricate rectangular vertical folding panels, to form an assembled system of dimensions indicated on Drawings and verified by field measurements.

1. Panel Size: Equal size, unless indicated otherwise.
2. Panel edge: Right angled, with 1/16-inch corner radius.

D. Trim: Manufacturer's standard trim with decorative, protective finish.

E. Hardware: Manufacturer's standard as required to operate operable panel partition and accessories; with decorative, protective finish.

1. Hinges: Manufacturer's standard.

F. Finish Facing: White marker board, both sides of each panel.

1. Paint exposed metal.

2.4 SEALS

A. General: Provide seals that produce operable panel partitions complying with performance requirements and the following:

1. Seals made from materials and in profiles that minimize sound leakage.

B. Seals fitting tight at contact surfaces and sealing continuously between adjacent panels and between operable panel partition perimeter and adjacent surfaces, when operable panel partition is extended and closed

2.5 PANEL FINISH FACINGS

A. Cap-Trimmed Edges: Protective perimeter-edge trim with tight hairline joints concealing edges of panel and finish facing, finished as follows:

1. Steel, Painted:

a. Color: As selected by Architect from Manufacturer's full range.

2.6 SUSPENSION SYSTEMS

A. Provide bushings, spacers, pins, discs, bearings, and sleeves that function quietly and with minimum wear throughout specified lifecycle of **v**ertical folding sound-rated partitions.

B. Hanging, Folding and Extension Mechanism: Structural grade aluminum extrusions and structural shapes.

C. Suspension Hangers: Steel with adjustable steel hanger rods for overhead support, designed for type of operation, size, and weight of **v**ertical folding sound-rated partitions indicated. Size hangers to support partition operation and storage without damage to suspension system, vertical folding sound-rated partitions, or adjacent construction. Limit deflection, independent of structural support, to no more than 80 percent of bottom clearance.

D. Steel Finish: Factory-applied, corrosion-resistant, protective coating, unless otherwise indicated.

2.7 LIFTING EQUIPMENT

A. Provide lifting mechanism that functions smoothly, quietly and safely. Wherever possible, use ball bearings instead of bushings and wear surfaces. Do not use chain or belt drive systems.

1. Size lifting equipment as required to efficiently close operable partition throughout the specified operation cycle of the vertical folding sound-rated partition assembly.

B. Provide wire rope cable as required for every set of lifting mechanisms. Use 6 by 31 galvanized steel or stainless steel construction aircraft cable. Size cables to support entire weight of the partition assembly, with the appropriate safety factor.

C. Warp cable on yoyo drums with 2 safety wraps and multiple layers of cable. Locate flange bearings on both sides of the drum assembly.

D. Provide line shaft to support and rotate cable drums, sized as required to deliver required torque with minimum deflection.

E. Provide power drive sized to deliver sufficient amount of torque to safely and effectively raise and lower vertical folding partitions throughout the specified operation cycle.

F. Comply with latest industry standards for lifting equipment with regards to thermal protection; overload protection, quick acting fuses, etc.

2.8 ELECTRIC OPERATORS

A. General: Provide Micro Drive System with motor assembly mounted directly to the slab above centerline of operable partition wall. Provide support steel, as specified in Division 05 sections, at locations as required by manufacturer.

B. Operation: Spring return, 3-position key switch, located on both sides of wall. Key allows continuous up or down movement until pressure is removed, at which time the partition immediately stops without coasting. Provide operation that allows partition to be partially lowered, stopped, and then reversed in direction as part of normal operation.

1. Operating speed: constant nominal speed no less than 5 vertical feet per minute.

C. Limit Switches: Provide adjustable switches, interlocked with motor controls and set to automatically stop door at fully opened and fully closed positions.

D. Obstruction Detection Device: Provide vertical folding partition with external automatic pressure sensing strip capable of protecting full width of opening. Activation of sensor immediately employs electromagnetic brake to stop downward operable partition travel and reactivates with key switch after removal of obstruction.

E. Emergency Brake Systems:

1. Electromagnetic Brake: Provide electromagnetic brake that activate, without hesitation, when power is lost to system. Provide brake with retarding torque rating of no less than 200 percent of power drive’s full load torque. Include manual break release lever on motor.
2. Dynamic Brake: Provide emergency dynamic brake in addition to electromagnetic brake specified above, to lower partition at controlled speed of no more than 150 percent of normal down speed, in the case of a catastrophic failure in the power train.

F. Over Torque Detector: Provide mechanical over torque detector to detect jams in the system and to act as an over travel limit in the up direction should the primary limit switch fail to act.

G. Power Supply: Three-phase power supply to standard NEMA 1electrical control box.

H. Low-Voltage Wiring: 18-gauge wiring from the switches to the control box.

I. Touch Screen Operator Stations: Two, 4.3-inch resistive LCD touch screens, wired in series with multilingual capabilities and 4-digit adjustable user pin. Screens display faults in case of a failure with the electrical system.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine flooring, structural support, and opening, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of operable panel partitions.

1. Floor Flatness Along Partition Axis For Vertical Rising Partitions: Flat to within +/- 1/4-inch along entire length of operable partition.

    a. Allowable peak to valley undulation of +/- 1/4-inch: No closer together than 24 inches.
    b. Allowable peak to valley undulation of +/- 1/8-inch: No closer than 12 inches.
    c. Support Steel Above Operable Partition with Floor: Install support steel parallel along its axis with floor within +/- 1/2 inch for entire length of the operable partition, accounting for loaded deflection. The beam must also be paralleled to the centre line of the wall within +/- 1/8 inch, left to right.
    d. Plumbness of Fixed Walls at Either End of the Operable Partition: Maximum 1/4-inch from plumb vertically.
    e. Flatness of Fixed Walls at Either End of the Operable Partition: Flat to within +0, -1/4 inch.

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

3.2 INSTALLATION

A. General: Comply with ASTM E 557 except as otherwise required by operable panel partition manufacturer's written installation instructions.

B. Install operable panel partitions and accessories after other finishing operations, including painting, have been completed in area of partition installation.

C. Install panels from marked packages in numbered sequence indicated on Shop Drawings.

D. Install operable wall that is visibly flat and rigid in the down position.

E. Broken, cracked, chipped, deformed, or unmatched panels are not acceptable.

F. Broken, cracked, deformed, or unmatched gasketing or gasketing with gaps at butted ends is not acceptable.

G. Light-Leakage Test: Illuminate one side of partition installation and observe vertical joints and top and bottom seals for voids. Adjust partitions for alignment and full closure of vertical joints and full closure along top and bottom seals.

3.3 ADJUSTING

A. Adjust operable panel partitions, hardware, and other moving parts to function smoothly, and lubricate as recommended by manufacturer.

B. Adjust to operate smoothly and easily, without binding or warping.

C. Verify that safety devices are properly functioning.

3.4 MAINTENANCE SERVICE

A. Maintenance Service: Beginning at Substantial Completion, maintenance service shall include 12 months' full maintenance by manufacturer's authorized service representative. Include quarterly preventive maintenance, repair or replacement of worn or defective components, lubrication, cleaning, and adjusting as required for proper operable-partition operation. Parts and supplies shall be manufacturer's authorized replacement parts and supplies.

3.5 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain operable panel partitions.

END OF SECTION 10 2238

SECTION 10 2600 - WALL AND DOOR PROTECTION

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Rub strip.

B. Related Requirements:

1. Section 08 7100 "Door Hardware" for metal protective trim units, according to BHMA A156.6, used for armor, kick, mop, and push plates.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Include construction details, material descriptions, impact strength, dimensions of individual components and profiles, and finishes.

B. Shop Drawings: For each type of wall and door protection showing locations and extent.

1. Include plans, elevations, sections, and attachment details.

C. Samples for Verification: For each type of exposed finish on the following products, prepared on Samples of size indicated below:

1. Wall Guards: 12 inches long. Include examples of joinery, corners, and field splices.

1.3 INFORMATIONAL SUBMITTALS

A. Material Certificates: For each type of exposed plastic material.

B. Sample Warranty: For special warranty.

1.4 CLOSEOUT SUBMITTALS

A. Maintenance Data: For each type of wall and door protection product to include in maintenance manuals.

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. Furnish extra materials, from the same product run, that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Wall-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, 96-inch- long units.
2. Mounting and Accessory Components: Amounts proportional to the quantities of extra materials. Package mounting and accessory components with each extra material.

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 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 MANUFACTURERS

A. Source Limitations: 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.

2.3 WALL GUARDS

A. Rub Strip: Continuous strip, consisting of minimum 0.060-inch- thick, semirigid, plastic sheet wall-covering material.

1. Basis-of-Design Product: Item CS (InPro Corp; Palladium Rub Rail) as indicated on Finish Legend in the drawings.

    a. Provide Basis-of-Design product or, subject to compliance with requirements, a comparable product approved by Architect prior to bid, by another Manufacturer.

2. Height: 12 inches nominal.
3. Color and Texture: As indicated on Finish Legend.
4. Mounting: Surface mounted with adhesive.

2.4 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. Adhesive: As recommended by protection product manufacturer.

1. Verify adhesives have a VOC content of 70 g/L or less.

2.5 FABRICATION

A. Fabricate wall protection according to requirements indicated for design, performance, dimensions, and member sizes, including thicknesses of components.

B. Factory Assembly: Assemble components in factory to greatest extent possible to minimize field assembly. Disassemble only as necessary for shipping and handling.

C. 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.

2.6 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 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.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates and wall areas, with Installer present, for compliance with requirements for installation tolerances 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

A. Installation Quality: Install wall and door protection according to manufacturer's written instructions, level, plumb, and true to line without distortions. Do not use materials with chips, cracks, voids, stains, or other defects that might be visible in the finished Work.

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 2600

SECTION 10 2800 - TOILET ACCESSORIES

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Public-use washroom accessories.
2. Underlavatory guards.
3. Custodial accessories.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product indicated. Include the following:

1. Construction details and dimensions.
2. Anchoring and mounting requirements, including requirements for cutouts in other work and substrate preparation.
3. Material and finish descriptions.
4. Features that will be included for Project.
5. Manufacturer's warranty.

B. Samples: Full size, for each accessory item to verify design, operation, and finish requirements.

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 on Drawings.
2. Identify products using designations indicated on Drawings.

1.3 INFORMATIONAL SUBMITTALS

A. Warranty: Sample of special warranty.

1.4 CLOSEOUT SUBMITTALS

A. Maintenance Data: For toilet accessories to include in maintenance manuals.

1.5 QUALITY ASSURANCE

A. Source Limitations: For products listed together in the same Part 2 articles, obtain products from single source from single manufacturer.

1.6 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.

1.7 WARRANTY

A. Special Mirror Warranty: Manufacturer's standard form in which manufacturer agrees to replace mirrors that develop visible silver spoilage defects and that fail in materials or workmanship within specified warranty period.

1. Warranty Period: 15 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 Basis of Design Products: Products indicated are basis of design. Provide the specified products or equivalent products complying with requirements, and approved by Architect prior to bid, by one of the following:

1. American Accessories, Inc.
2. American Specialties, Inc.
3. Bobrick Washroom Equipment, Inc.
4. Bradley Corporation.

2.2 MATERIALS

A. Stainless Steel: ASTM A 666, Type 304, 0.031-inch minimum nominal thickness unless otherwise indicated.

B. Fasteners: Screws, bolts, and other devices of same material as accessory unit and tamper-and-theft resistant where exposed, and of galvanized steel where concealed.

C. Mirrors: ASTM C 1503, Mirror Glazing Quality, clear-glass mirrors, nominal 6.0 mm thick.

D. ABS Plastic: Acrylonitrile-butadiene-styrene resin formulation.

2.3 PUBLIC-USE WASHROOM ACCESSORIES

A. Toilet Tissue (Roll) Dispenser:

1. Product: Bradley Model 5234
2. Description: Double-roll dispenser.
3. Mounting: Surface mounted.
4. Operation: Non-controlled delivery.
5. Capacity: Designed for 5-1/2-inch- diameter tissue rolls.
6. Material and Finish: Chrome-plated zinc alloy (zamac) or steel.

B. Combination Towel (Folded) Dispenser/Waste Receptacle:

1. Product: Bradley Model 2291
2. Description: Low-capacity combination unit for dispensing C-fold or multifold towels, with removable waste receptacle.
3. Mounting: Recessed mounted.
4. Minimum Towel-Dispenser Capacity: 350 C-fold or 450 multifold paper towels.
5. Minimum Waste-Receptacle Capacity: 2 gal.
6. Material and Finish: Stainless steel, No. 4 finish (satin).
7. Lockset: Tumbler type for towel-dispenser compartment.

C. Liquid-Soap Dispenser:

1. Product: Automatic soap dispenser matching automatic faucets specified in Section 22 4200 “Plumbing Fixtures.”
2. Description: Designed for dispensing soap in liquid or lotion form.
3. Mounting: Deck mounted on lavatory.
4. Capacity: 16 oz.
5. Materials: Type 316 stainless steel.
6. Lockset: Tumbler type.
7. Refill Indicator: Window type.

D. Grab Bar:

1. Product: Bradley Model 812
2. Mounting: Flanges with concealed fasteners.
3. Material: Stainless steel, 0.05 inch thick.

    a. Finish: Smooth, No. 4, satin finish.

4. Outside Diameter: 1-1/2 inches.
5. Configuration and Length: As indicated on Drawings.

E. Vendor:

1. Product: Bradley Recessed Model 4017-10.
2. Type: Sanitary napkin and tampon.
3. Mounting: Fully recessed, designed for 4-inch wall depth or surface mounted as indicated.

4. Capacity: 30 napkins and 28 tampons.
5. Operation: Free operation.
6. Exposed Material and Finish: Stainless steel, No. 4 finish (satin)
7. Lockset: Tumbler type with separate lock and key for coin box.

F. Sanitary-Napkin Disposal Unit:

1. Product: Bradley Recessed Model 4713-15.
2. Mounting: Recessed.
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, No. 4 finish (satin).

G. Mirror Unit:

1. Product: Bradley Model 781
2. Frame: Roll-formed decorative stainless-steel channel, 3/4 by 3/4 inch.

    a. Corners: Manufacturer's standard.
    b. Provide one custom-length frame for all mirrors on a wall. Where a single pane of mirror glass is not practical, vertically butt-glaze two or more equal-sized mirror panes within the one frame.

3. Mirror: 1/4-inch tempered glass
4. Integral Shelf: 5 inches deep.
5. Hangers: Produce rigid, tamper- and theft-resistant installation, using method indicated below.

    a. One-piece, galvanized steel, wall-hanger device with spring-action locking mechanism to hold mirror unit in position with no exposed screws or bolts.

6. Size: As indicated on Drawings.

H. Robe Hook:

1. Product: Bradley Model 9124
2. Description: Double-prong unit.
3. Material and Finish: Stainless steel, No. 4 finish (satin).

2.4 CHILDCARE ACCESSORIES

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. American Specialties, Inc.
2. Brocar Products, Inc.
3. GAMCO Specialty Accessories; a division of Bobrick Washroom Equipment, Inc.
4. Koala Kare Products; a division of Bobrick Washroom Equipment, Inc.

2.5 WARM-AIR HAIR DRYERS

A. Warm-Air Hair Dryer:

1. Product: Oster Model 76932-710.
2. Mounting: Surface mounted.
3. Operation: Touch-button activated with timed power cut-off switch.
4. Cover Material and Finish: Molded plastic, white.
5. Electrical Requirements: 115 V, 13 A, 1500 W.

2.6 UNDERLAVATORY GUARDS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Plumberex Specialty Products, Inc.
2. TCI Products.
3. Truebro, Inc.

B. Underlavatory Guard:

1. Description: Insulating pipe covering for supply and drain piping assemblies, that prevent direct contact with and burns from piping, and allow service access without removing coverings.
2. Material and Finish: Antimicrobial, molded-plastic, white.

2.7 CUSTODIAL ACCESSORIES

A. Mop and Broom Holder:

1. Product: Bradley Model 9954
2. Description: Unit with holders on plated steel retainers.
3. Length: 36 inches.
4. Mop/Broom Holders: Four, spring-loaded, rubber hat, cam type.
5. Material and Finish: Stainless steel, No. 4 finish (satin).

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

A. Install accessories according to manufacturers' written instructions, using fasteners appropriate to substrate indicated and recommended by unit manufacturer. Install units level, plumb, and firmly anchored in locations and at heights indicated.

B. Grab Bars: Install to withstand a downward load of at least 250 lbf, when tested according to ASTM F 446.

3.2 ADJUSTING AND CLEANING

A. Adjust accessories for unencumbered, smooth operation. Replace damaged or defective items.

B. Remove temporary labels and protective coatings.

C. Clean and polish exposed surfaces according to manufacturer's written recommendations.

END OF SECTION 10 2800

SECTION 10 4413 - FIRE PROTECTION CABINETS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Fire-protection cabinets for the following:

a. Portable fire extinguisher.

B. Related Requirements:

1. Section 10 4416 "Fire Extinguishers" for portable, hand-carried fire extinguishers accommodated by fire-protection cabinets.

1.2 PREINSTALLATION CONFERENCE

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 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.

B. Shop Drawings: For fire-protection cabinets.

1. Include plans, elevations, sections, details, and attachments to other work.

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 to include in maintenance manuals.

1.5 COORDINATION

A. Coordinate size of fire-protection cabinets to ensure that type and capacity of fire extinguishers indicated are accommodated.

PART 2 - PRODUCTS

2.1 SOURCE LIMITATIONS

A. Obtain fire-protection cabinets, accessories, and fire extinguishers from single source from single manufacturer.

2.2 FIRE-PROTECTION CABINET

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Babcock-Davis.
2. Croker; a Division of Morris Group International.
3. Guardian Fire Equipment, Inc.
4. JL Industries; Activar Construction Products Group, Inc.
5. Larsen's Manufacturing Company.
6. MOON American, Inc.
7. Modern Metal Products.
8. Nystrom, Inc.
9. Potter Roemer LLC; a Division of Morris Group International.
10. Strike First Corporation of America.

B. Fire-Protection Cabinet Type: Suitable for fire extinguisher.

C. Cabinet Construction: Nonrated.

D. Cabinet Material: Cold-rolled steel sheet.

1. Shelf: Same metal and finish as cabinet.

E. Surface-Mounted Cabinet: Cabinet box fully exposed and mounted directly on wall with no trim.

F. Cabinet Trim Material: Steel sheet.

G. Door Material: Steel sheet.

H. Door Style: Vertical duo panel with frame.

I. Door Glazing: Tempered float glass (clear).

J. Door Hardware: Manufacturer's standard door-operating hardware of proper type for cabinet type, trim style, and door material and style indicated.

1. Provide projecting lever handle with cam-action latch.
2. Provide continuous hinge, of same material and finish as trim, permitting door to open 180 degrees.

K. Accessories:

1. Mounting Bracket: Manufacturer's standard steel, designed to secure fire extinguisher to fire-protection cabinet, of sizes required for types and capacities of fire extinguishers indicated, with plated or baked-enamel finish.
2. Lettered Door Handle: One-piece, cast-iron door handle with the word "FIRE" embossed into face.
3. Identification: Lettering complying with authorities having jurisdiction for letter style, size, spacing, and location. Locate as directed by Architect.

a. Identify fire extinguisher in fire-protection cabinet with the words "FIRE EXTINGUISHER."

1) Location: Applied to cabinet door.
2) Application Process: Pressure-sensitive vinyl letters.
3) Lettering Color: Black.
4) Orientation: Vertical.

L. Materials:

1. Cold-Rolled Steel: ASTM A1008/A1008M, Commercial Steel (CS), Type B.

a. Finish: Baked enamel, TGIC polyester powder coat, HAA polyester powder coat, epoxy powder coat, or polyester/epoxy hybrid powder coat, complying with AAMA 2603.
b. Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions.
c. Color: As selected by Architect from manufacturer's full range.

2. Tempered Float Glass: ASTM C1048, Kind FT, Condition A, Type I, Quality q3, 3 mm thick, Class 1 (clear).

2.3 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.

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 thick.
2. 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.

2.4 GENERAL FINISH REQUIREMENTS

A. Comply with NAAMM's AMP 500, "Metal Finishes Manual for Architectural and Metal Products," for 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. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION OF FIRE-PROTECTION CABINETS

A. General: Install fire-protection cabinets in locations and at mounting heights indicated or, if not indicated, at height indicated below:

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. Fasten mounting brackets to inside surface of fire-protection cabinets, square and plumb.

C. Identification:

1. Apply vinyl lettering at locations indicated.

3.3 ADJUSTING AND CLEANING

A. Remove temporary protective coverings and strippable films, if any, as fire-protection cabinets are 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.

C. On completion of fire-protection cabinet installation, clean interior and exterior surfaces as recommended by manufacturer.

D. 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.

E. 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 4413

SECTION 10 4416 - FIRE EXTINGUISHERS

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes portable, hand-carried fire extinguishers.

B. Related Requirements:

1. Section 10 4413 "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.

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.

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.

2.2 PORTABLE, HAND-CARRIED FIRE EXTINGUISHERS

A. Fire Extinguishers: Type, size, and capacity for each fire-protection cabinet indicated.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Amerex Corporation.
b. Ansul by Johnson Controls Company.
c. Babcock-Davis.
d. Badger Fire Protection.
e. Buckeye Fire Equipment Company.
f. Fire End & Croker Corporation.
g. Guardian Fire Equipment, Inc.
h. JL Industries, Inc.; a division of the Activar Construction Products Group.
i. Kidde Residential and Commercial Division.
j. Larsens Manufacturing Company.
k. MOON American.
l. Nystrom.

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: Stainless steel.
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: UL-rated 4-A:60-B:C, 10-lb nominal capacity, with monoammonium phosphate-based dry chemical in enameled-steel container.

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 in locations indicated and in compliance with requirements of authorities having jurisdiction.

1. Mounting Brackets: Top of fire extinguisher to be at 42 inches above finished floor.

B. Provide fire extinguishers in all elevator equipment rooms.

END OF SECTION 10 4416

SECTION 10 5123 - PLASTIC-LAMINATE-CLAD LOCKERS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Plastic-laminate-clad wood lockers.

1.2 ACTION SUBMITTALS

A. Product Data:

1. Plastic-laminate-clad wood lockers.

B. Product Data Submittals: For each product.

1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for each type of locker.

C. Shop Drawings: For plastic-laminate-clad wood lockers.

1. Include plans, elevations, sections, and attachment details.
2. Show locations and sizes of furring, blocking, and hanging strips, including concealed blocking and reinforcement specified in other Sections.
3. Show locations and sizes of cutouts and holes for items installed in lockers.
4. Show locker fillers, trim, base, sloping tops, and accessories.
5. Show locker identification system and numbering sequence.

D. Samples for Initial Selection: For each type of the following:

1. High-pressure decorative laminates.
2. Thermally fused laminate overlay panels.

E. Samples for Verification: For the following products:

1. Plastic-laminate-clad panels, not less than 8 by 10 inches, for each type, color, pattern, and surface finish.
2. Thermally fused laminate-overlay-surfaced panels, not less than 8 by 10 inches, for each type, color, pattern, and surface finish.
3. Corner pieces of locker front frame joints between stiles and rail, as well as exposed end pieces, not less than 18 inches wide by 18 inches high by 6 inches deep.
4. Exposed cabinet hardware and accessories, one unit for each type and finish.

1.3 INFORMATIONAL SUBMITTALS

A. Qualification Data: For Installer.

B. Sample Warranty: For special warranty.

1.4 CLOSEOUT SUBMITTALS

A. Maintenance Data: For adjusting, repairing, and replacing locker doors and latching mechanisms to include in maintenance manuals.

1.5 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. Locker doors, complete with specified door hardware. Furnish no fewer than five doors of each type and color installed.
2. Units of the following locker hardware items equal to 10 percent of amount installed for each type and finish installed, but no fewer than five units:

a. Hinges.
b. Pulls.
c. Cylinder locks.
d. Blank identification plates and holders.
e. Hooks.

1.6 QUALITY ASSURANCE

A. Mockups: 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 corner, including one locker on each side of corner and corner filler, including door panel with specified door hardware, as shown on Drawings.
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. Do not deliver lockers until painting and similar operations that could damage lockers have been completed in installation areas. If lockers must be stored in other-than-installation areas, store only in areas where environmental conditions are the same as those in final installation location, and comply with requirements specified in "Field Conditions" Article.

B. Deliver master and control keys to Owner by registered mail or overnight package service.

1.8 FIELD CONDITIONS

A. Environmental Limitations: Do not deliver or install lockers 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.

B. Field Measurements: Where lockers are indicated to fit to other construction, verify dimensions of other construction by field measurements before fabrication, and indicate measurements on Shop Drawings.

1. Locate concealed framing, blocking, and reinforcements that support lockers by field measurements before being enclosed, and indicate measurements on Shop Drawings.

C. Established Dimensions: Where lockers are indicated to fit to other construction, establish dimensions for areas where lockers are to fit. Provide allowance for trimming at site, and coordinate construction to ensure that actual dimensions correspond to established dimensions.

1.9 COORDINATION

A. Coordinate sizes and locations of concealed wood support bases.

1. Requirements are specified in Section 06 1000 "Rough Carpentry."

B. Coordinate sizes and locations of framing, blocking, furring, reinforcements, and other related units of work specified in other Sections to ensure that lockers can be supported and installed as indicated.

C. Hardware Coordination: Distribute copies of approved hardware schedule specified in Section 08 7100 "Door Hardware" to fabricator of lockers; coordinate Shop Drawings and fabrication with hardware requirements.

1.10 WARRANTY

A. Special Warranty: Manufacturer agrees to repair or replace components of lockers 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 of locks or hardware.
c. Deterioration of wood, finishes, and other materials beyond normal use.

2. Warranty Period: Three years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Accessibility Standard: For lockers indicated to be accessible, comply with applicable provisions in the USDOJ's "2010 ADA Standards for Accessible Design" and ICC A117.1.

2.2 PLASTIC-LAMINATE-CLAD WOOD LOCKERS

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. Classic Woodworking, LLC.
2. Club Resource Group.
3. Famous Lockers.
4. Hollman, Inc.
5. Ideal Products, Inc.
6. Legacy Lockers.
7. List Industries Inc.
8. Treeforms.
9. Equal.

B. Construction Style: Flush overlay.

C. Final Assembly: Manufacturer's standard factory or knocked-down assembly.

D. Locker Body: Fabricated from particleboard-core panels covered on both sides with thermally fused laminate overlay.

1. Side Panels: Manufacturer's standard 3/4 or 5/8 inch thick.
2. Back Panel: Manufacturer's standard 1/2 or 3/8 inch thick.
3. Top Panel: Manufacturer's standard 3/4 or 5/8 inch thick.
4. Bottom Panel: Manufacturer's standard 3/4 or 5/8 inch thick.
5. Exposed Panel Edges: 3-mm-thick PVC.

E. Plastic-Laminate-Clad Wood Doors: High-pressure decorative laminate, Grade VGS, over both sides of particleboard core.

1. Thickness: Manufacturer's standard 3/4 or 5/8 inch thick.
2. Panel Edges: 3-mm-thick PVC.

F. End Panels: Match style, material, construction, and finish of plastic-laminate-clad wood doors.

G. Corners and Filler Panels: 3/4-inch-thick panels. Match style, material, construction, and finish of plastic-laminate-clad wood doors.

H. Continuous Finish Base: Plastic-laminate-clad, 3/4-inch-thick panel that matches door faces; fabricated in lengths as long as practical to enclose base and base ends of lockers.

I. Plastic-Laminate Colors, Patterns, and Finishes:

1. As selected by Architect from plastic-laminate manufacturer's full range of wood grains.

2.3 MATERIALS

A. Composite Wood: Provide materials that comply with requirements of referenced quality standard for each type of woodwork and quality grade specified unless otherwise indicated.

1. Thermally Fused Laminate (TFL) Panels: Particleboard or medium-density fiberboard finished with thermally fused, melamine-impregnated decorative paper.
2. Particleboard: ANSI A208.1, Grade M-2.

B. High-Pressure Decorative Laminate: ISO 4586-3, grades as follows:

1. Horizontal Surfaces: Grade HGS.
2. Postformed Surfaces: Grade HGP.
3. Vertical Surfaces: Grade VGS.

C. Furring, Blocking, Shims, and Hanging Strips: Softwood or hardwood lumber, kiln dried to less than 15 percent moisture content.

D. Anchors: Material, type, size, and finish as required for each substrate for secure anchorage. Provide metal expansion sleeves or expansion bolts for post-installed anchors. Use nonferrous-metal or hot-dip galvanized anchors and inserts at inside face of exterior walls and at floors.

E. Wood Support Base: 2-by-4-inch nominal-size lumber treated with manufacturer's standard preservative-treatment, pressure process.

2.4 HARDWARE

A. Cylinder Lock: Built-in, flush cam locks with five-pin tumbler keyway, keyed separately and master keyed. Furnish two change keys for each lock and two master keys.

1. Key Type: Flat, with minimum 2-by-2.68-inch key head for accessible lockers.
2. Bolt Operation: Manually locking deadbolt or automatically locking spring bolt.

B. Semiconcealed Hinges: Single-pivot, spring-loaded steel hinges; back mounted.

1. Provide two hinges for doors [**36 inches**] [**42 inches**] high and less.
2. Provide three hinges for doors more than [**36 inches**] [**42 inches**] high.

C. Frameless Hinges (European Type): Fully concealed, nickel-plated steel, with not less than 125 degrees of opening.

1. Provide two hinges for doors 36 inches high and less.
2. Provide three hinges for doors more than 36 inches high.

D. Wire Pulls: Back mounted; 4 inches long, 5/16 inch in diameter.

E. Accessible Handle: Metal, fixed, graspable lever handle and rose trim; surface mounted.

F. Hooks: Manufacturer's standard, ball-pointed aluminum or steel; chrome finished. Attach hooks with at least two fasteners.

1. Provide one double-prong ceiling hook for each compartment of two-tier interlocking Z lockers.

G. Coat Rods: 3/4-inch- diameter steel; chrome finished.

1. Provide coat rod for each compartment of double-tier interlocking Z lockers.

H. Exposed Hardware Finish:

1. Polished chrome unless otherwise indicated.
2. Unless otherwise indicated, provide finish that complies with BHMA A156.18 for BHMA finish number indicated.

a. Satin Chromium Plated: BHMA 626 for brass or bronze base; BHMA 652 for steel base.

2.5 ACCESSORIES

A. Protective Mats: 1/8-inch-thick, solid rubber.

B. Name Identification Plates and Plate Holders: 1-inch-high by 4-inch-wide, etched, embossed, or stamped, aluminum plates with black letters at least 1/2 inch high. Identify lockers as indicated on Drawings. Finish nameplates and holders to match other locker hardware.

2.6 FABRICATION

A. Fabricate each locker with shelves, an individual door and frame, an individual top, a bottom, and a back, and with common intermediate uprights separating compartments.

1. Fabricate lockers to dimensions, profiles, and details indicated.
2. Ease edges of corners of solid-wood members to 1/16-inch radius.

B. Fabricate lockers square, rigid, without warp, and with finished faces flat and free of dents, scratches, and chips. Accurately factory machine components for attachments. Make joints tight and true.

1. Fabricate lockers using manufacturer's standard construction, with joints made with dowels, dados, or rabbets. Dado side panels to receive shelving except where indicated to be adjustable.
2. Fabricate lockers with joints that are dadoed or rabbeted, glued full length, and stapled. Dado side panels to receive shelving except where indicated to be adjustable.

3. Join drawer subfronts, backs, and sides with manufacturer's standard glued joints.

C. Accessible Lockers: Fabricate as follows:

1. Locate bottom shelf no lower than 15 inches above the floor.
2. Where hooks, coat rods, or additional shelves are provided, locate no higher than 48 inches above the floor.

D. Venting: Fabricate lockers with space between doors and locker assembly of not less than 3/4 inch, with painted metal security screen attached to each shelf between doors.

E. Number Identification Plates: Inlay number plates flush in each locker door, near top, centered.

F. Complete fabrication, including assembly, finishing, and hardware application, to maximum extent possible, before shipment to Project site. Disassemble components only as necessary for shipment and installation. Where necessary for fitting at site, provide ample allowance for scribing, trimming, and fitting.

1. Use only manufacturer's nuts, bolts, screws, and other devices for assembly.

G. Shop cut openings, to maximum extent possible, to receive hardware, 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.

H. Attach PVC edging to panels by thermally fusing edging to panels after panel fabrication.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine walls and floors or support bases, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.

B. Verify that furring is attached to concrete and masonry walls that are to receive lockers.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Condition lockers to average prevailing humidity conditions in installation areas before installation.

B. Before installing lockers, examine factory-fabricated work for completeness and complete work as required, including removal of packing.

3.3 INSTALLATION

A. Install wood support base with 1/2-inch-thick, plywood top.

B. Knocked-Down Lockers: Assemble with manufacturer's standard fasteners, with no exposed fasteners on face frames.

C. Install lockers level, plumb, and true; use concealed shims.

D. Connect groups of lockers together with manufacturer's standard[**brass-finished**] fasteners, through predrilled holes, with no exposed fasteners on face frames. Fit lockers accurately together to form flush, tight, hairline joints.

E. Install lockers without distortion so doors and drawers fit openings properly and are accurately aligned. Adjust hardware to center doors and drawers in openings, providing unencumbered operation. Complete installation of hardware and accessory items as indicated.

1. Installation Tolerance: No more than 1/8 inch in 96-inch sag, bow, or other variation from a straight line. Shim as required with concealed shims.

F. Locker Anchorage:

1. Fasten lockers through back, near top and bottom, at ends with No. 8 flush-head wood screws sized for 1-inch penetration into wood framing, blocking, or furring and spaced not more than 16 inches o.c.

G. Scribe and cut corner and filler panels to fit adjoining work using fasteners concealed where practical. Repair damaged finish at cuts.

H. Install name identification plates and holders after lockers are in place.

1. Attach number identification plate on each locker door, near top, centered, with at least two screws with finish matching the plate.

I. Provide protective mat at each shoe shelf.

3.4 ADJUSTING

A. Clean, lubricate, and adjust hardware. Adjust doors to operate easily without binding. Verify that locking devices operate properly.

3.5 PROTECTION

A. Protect lockers from damage, abuse, dust, dirt, stain, or paint. Do not permit use during construction.

B. Touch up marred finishes, or replace lockers that cannot be restored to factory-finished appearance. Use only materials and procedures recommended or furnished by locker manufacturer.

END OF SECTION 10 5123

SECTION 11 3013 - RESIDENTIAL APPLIANCES

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Cooking appliances.
2. Refrigeration appliances.

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. Include installation details, material descriptions, dimensions of individual components, and finishes for each appliance.
2. Include rated capacities, operating characteristics, electrical characteristics, and furnished accessories.

B. Product Schedule: For appliances.

1.4 INFORMATIONAL SUBMITTALS

A. Qualification Data: For manufacturer.

B. Product Certificates: For each type of appliance.

C. Field quality-control reports.

D. Sample Warranties: For manufacturers' special warranties.

1.5 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For each residential appliance to include in operation and maintenance manuals.

1.6 QUALITY ASSURANCE

A. Manufacturer Qualifications: Maintains, within <Insert number> miles of Project site, a service center capable of providing training, parts, and emergency maintenance repairs.

1.7 WARRANTY

A. Special Warranties: Manufacturer agrees to repair or replace residential appliances or components that fail in materials or workmanship within specified warranty period except as qualified below:

1. Warranty Period: Five years from date of Substantial Completion.

B. Microwave Oven: Full warranty, including parts and labor, for on-site service on the magnetron tube.

1. Warranty Period: Five years from date of Substantial Completion.

C. Refrigerator/Freezer, Sealed System: Full warranty, including parts and labor, for on-site service on the product.

1. Warranty Period for Sealed Refrigeration System: Five years from date of Substantial Completion.
2. Warranty Period for Other Components: Two years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Source Limitations: Obtain residential appliances from single source and each type of residential appliance from single manufacturer.

2.2 PERFORMANCE REQUIREMENTS

A. Electrical Appliances: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

B. Accessibility: Where residential appliances are indicated to comply with accessibility requirements, comply with applicable provisions in the DOJ's 2010 ADA Standards for Accessible Design and ICC A117.1.

2.3 MICROWAVE OVENS

A. ADA Microwave Oven:

1. Product: Subject to compliance with requirements, provide the following:

a. Haier Group (GE Appliances); JES1657SMSS.

2. Mounting: Countertop.
3. Dimensions:

a. Width: 21-3/4 inches.
b. Depth: 17-3/4 inches.
c. Height: 12-7/8 inches.

4. Capacity: 1.6 cu. ft.
5. Oven Door: Door with observation window and pushbutton latch release.
6. Microwave Power Rating: 1150 W.
7. Electric Power Supply: 120 V, 60 Hz, 1 phase, 15 A.
8. Controls: Digital panel controls and timer display.
9. Other Features: Turntable.
10. Material: Stainless steel.

2.4 REFRIGERATOR/FREEZERS

A. ADA Refrigerator/Freezer: Two-door refrigerator/freezer with freezer on top and complying with AHAM HRF-1.

1. Product: Subject to compliance with requirements, provide the following:

a. Samsung; RT18M6215SR.

2. Type: Built in.
3. Dimensions:

a. Width: 28-3/4 inches.
b. Depth: 31-7/8 inches.
c. Height: 65-3/4 inches.

4. Storage Capacity:

a. Refrigeration Compartment Volume: 27.7 cu. ft.
b. Freezer Volume: 4.9 cu. ft.
c. Shelf Area: One adjustable glass shelf.

5. General Features:

a. Door Configuration: Overlay.

6. Refrigerator Features:

a. Interior light in refrigeration compartment.
b. Compartment Storage: Vegetable crisper and meat compartment.
c. Door Storage: Modular compartments.

7. Freezer Features: One freezer compartment with door.

    a. Interior light in freezer compartment.
    b. Automatic icemaker and storage bin.

8. Appliance Color/Finish: Stainless steel.

2.5 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 and are assembled or installed to minimize contrast.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances, power connections, and other conditions affecting installation and performance of residential appliances.

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

A. Install appliances according to manufacturer's written instructions.

B. Freestanding Equipment: Place units in final locations after finishes have been completed in each area. Verify that clearances are adequate to properly operate equipment.

C. Range Anti-Tip Device: Install at each range according to manufacturer's written instructions.

3.3 FIELD QUALITY CONTROL

A. Perform the following tests and inspections:

1. Perform visual, mechanical, and electrical inspection and testing for each appliance according to manufacturers' written recommendations. Certify compliance with each manufacturer's appliance-performance parameters.
2. Leak Test: After installation, test for leaks. Repair leaks and retest until no leaks exist.

3. Operational Test: After installation, start units to confirm proper operation.
4. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and components.

B. An appliance will be considered defective if it does not pass tests and inspections.

C. Prepare test and inspection reports.

3.4 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain residential appliances.

END OF SECTION 11 3013

SECTION 115200 - AUDIO / VISUAL SYSTEM

PART 1 GENERAL

1.1 SUMMARY

A. Includes But Not Limited To:

1. Furnish and install the following as described in Contract Documents:

a. All Audio / Visual system conduits and conductors. Terminate to all A/V equipment as detailed on the drawings.

B. Products Supplied And Installed Under This Section:

1. Amplifier.
2. Speakers and accessories.
3. Audio system user interface.
4. Volume Controls.
5. Audio / visual control racks.
6. Bell System Controller

C. Related Sections:

1. Division 06: Architectural Woodwork.

a. Speaker mounting and enclosures.

2. Division 26:

a. Raceways, boxes and connections, trench ducts, equipment, fittings, and related cables.

b. Power to equipment locations including 220v/120v step-down transformers as required.

1.2 SUBMITTALS

A. Shop Drawings: Include Manufacturer's data sheets.

B. Closeout:

1. Operations and Maintenance Manual:

a. Bind manual in three-ring, hard backed binder with clear plastic pocket on spine. Spine of each binder shall have following typewritten lettering inserted:

AUDIO / VISUAL.

RECORD DOCUMENTS.

for Audio Visual System of

Logan Seminary.

b. Provide master index at the beginning of the manual showing items included. Use plastic tab indices for each of following sections:

1) Project data, including:

a) Names, addresses, and phone numbers of Architect, Sound / Acoustic Consultant, General Contractor, Electrical Subcontractor, and Sound Installer.

b) Address of building.

c) LDS Church Property Number of building.

2) Equipment:

a) List of equipment items provided showing quantity, make, model, and serial numbers.

b) Indicate if items are installed or portable.

c) Include Manufacturer's specification sheets for each item and Manufacturer's installation, operation, and maintenance manuals supplied with equipment.

3) Provide divider and space for system test report supplied by Sound / Acoustic consultant at time of final inspection:

4) System Specifications: Include copies of those portions of Divisions 01, 13, and 16 applying to sound and video systems.

5) System Drawings: Provide divider and space for folded reduced copies of record drawings that will be sent by Architect or consultant to Owner later.

c. Submit two complete manuals as required by Division 01 at time of equipment commissioning. Provide one additional copy and leave with building custodian.

1.3 QUALITY ASSURANCE

A. Qualifications:

B. Pre-Installation Conference:

1. Schedule Pre-Installation Conference before installation of audio / visual system.

2. In conjunction with pre-installation conference, inspect building to confirm initial construction will adequately receive audio / visual equipment.

3. Owner will provide Pre-Installation Checklist to be used for pre-installation inspection.

PART 2 PRODUCTS

2.1 COMPONENTS

A. As scheduled on Drawings.

B. Approved Equipment Supplier: As scheduled on Drawings.

PART 3 EXECUTION

3.1 ACCEPTABLE INSTALLERS

A. Contact Information:

1. Audiovision Plus, Layton, UT (801) 552-900 attention: Nate Mansfield.
2. General Communications, Murray, UT (801) 266-5731.
3. Marshal Industries, Salt Lake City, UT (801) 266-2428

3.2 PREPARATION

A. Preliminary Inspection:

1. Inspect building after installation of conduit and prior to cover-up to confirm construction has included appropriate initial work relating to audio / visual system.
2. Verify compliance of the following items before beginning system installation.
   a. No video cables spliced.
   b. Cables marked at each end with permanent wire labels.
   c. Specified cables and equipment cabinets are properly installed.
3. Organize and place all spare parts, installation materials, and supplies in designated cabinets and drawers.

3.3 INSTALLATION

A. Cables:

1. Leave sufficient service loops of uniform length on cables to allow operation of system with chassis outside cabinet.
2. Make cable connections and terminations with appropriately crimped or soldered connector.
3. Terminate conductors with proper mating connectors. Do not use adapters. Use proper crimp tool as recommended by Manufacturer of terminations, i.e., spade lugs, TV connectors, etc. Use controlled duty cycle ratcheting crimp tools of proper size for spade lugs and Molex pins.
4. Secure cables to panel with wire ties to ensure neat installation. Do not use double-stick tape or sticky-back cable anchors. Keep high level and low-level circuits in separate runs and bundles.

3.4 DEMONSTRATION

A. Completely check, calibrate, and test connected hardware and software to insure system performs in accordance with Contract Documents and sequences of operation submitted.

B. Demonstrate complete system operation for Owner.

C. Final Acceptance:

1. System commissioning will be performed.
2. Written acceptance sign-off of system operation will then occur and warranty will begin. Acceptance will be signed.

END OF SECTION 115200

SECTION 12 2413 - ROLLER WINDOW SHADES

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Manually operated roller shades with single rollers.
2. Motor-operated roller shades with single rollers.

B. Related Requirements:

1. Section 06 1000 "Rough Carpentry" for wood blocking and grounds for mounting roller shades and accessories.
2. Section 07 9200 "Joint Sealants" for sealing the perimeters of installation accessories for light-blocking shades with a sealant.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Include construction details, material descriptions, dimensions of individual components and profiles, features, finishes, and operating instructions for roller shades.

B. Shop Drawings: Show fabrication and installation details for roller shades, including shadeband materials, their orientation to rollers, and their seam and batten locations.

1. Motor-Operated Shades: Include details of installation and diagrams for power, signal, and control wiring.

C. Samples for Initial Selection: For each type and color of shadeband material.

1. Include Samples of accessories involving color selection.

D. Samples for Verification: For each type of roller shade.

1. Shadeband Material: Not less than 10 inches square. Mark interior face of material if applicable.
2. Roller Shade: Full-size operating unit, not less than 16 inches wide by 36 inches long for each type of roller shade indicated.
3. Installation Accessories: Full-size unit, not less than 10 inches long.

E. Product Schedule: For roller shades. Use same designations indicated on Drawings.

1.3 INFORMATIONAL SUBMITTALS

A. Qualification Data: For Installer.

B. Product Certificates: For each type of shadeband material.

C. Product Test Reports: For each type of shadeband material, for tests performed by a qualified testing agency.

1.4 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For roller shades to include in maintenance manuals.

1.5 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. Roller Shades: Full-size units equal to 5 percent of quantity installed for each size, color, and shadeband material indicated, but no fewer than two units.

1.6 QUALITY ASSURANCE

A. Installer Qualifications: Fabricator of products.

B. Mockups: Build mockups to verify selections made under Sample submittals, to demonstrate aesthetic effects, and to set quality standards for fabrication and installation.

1. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Architect specifically approves such deviations in writing.
2. 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. Deliver roller shades in factory packages, marked with manufacturer, product name, and location of installation using same designations indicated on Drawings.

1.8 FIELD CONDITIONS

A. Environmental Limitations: Do not install roller shades until construction and finish work in spaces, including painting, is complete and dry and ambient temperature and humidity conditions are maintained at the levels indicated for Project when occupied for its intended use.

B. Field Measurements: Where roller shades are indicated to fit to other construction, verify dimensions of other construction by field measurements before fabrication and indicate measurements on Shop Drawings. Allow clearances for operating hardware of operable glazed units through entire operating range. Notify Architect of installation conditions that vary from Drawings. Coordinate fabrication schedule with construction progress to avoid delaying the Work.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Source Limitations: Obtain roller shades from single source from single manufacturer.

2.2 MANUALLY OPERATED SHADES WITH SINGLE ROLLERS

A. Manufacturer:

1. Subject to compliance with requirements, provide products approved by Architect by one of the following:

    a. Draper Inc.
    b. Hunter Douglas Contract.
    c. Lutron Electronics Co., Inc.
    d. MechoShade Systems, Inc

B. Chain-and-Clutch Operating Mechanisms: With continuous-loop bead chain and clutch that stops shade movement when bead chain is released; permanently adjusted and lubricated.

1. Bead Chains: Stainless steel.

    a. Loop Length: Full length of roller shade.
    b. Limit Stops: Provide upper and lower ball stops.
    c. Chain-Retainer Type: Chain tensioner, jamb mounted with very-high-bond tape.

        1) Product: 3M VHB tape or equivalent high bond tape approved by Architect.

2. Spring Lift-Assist Mechanisms: Manufacturer's standard for balancing roller-shade weight and lifting heavy roller shades.

    a. Provide for shadebands that weigh more than 10 lb or for shades as recommended by manufacturer, whichever criteria are more stringent.

C. Rollers: Corrosion-resistant steel or extruded-aluminum tubes of diameters and wall thicknesses required to accommodate operating mechanisms and weights and widths of shadebands indicated without deflection. Provide with permanently lubricated drive-end assemblies and idle-end assemblies designed to facilitate removal of shadebands for service.

1. Roller Drive-End Location: Right side of inside face of shade, unless indicated otherwise.
2. Direction of Shadeband Roll: Regular, from back of roller.
3. Shadeband-to-Roller Attachment: Manufacturer's standard method.

D. Mounting Hardware: Brackets or endcaps, corrosion resistant and compatible with roller assembly, operating mechanism, installation accessories, and mounting location and conditions indicated.

E. Roller-Coupling Assemblies: Coordinated with operating mechanism and designed to join up to three inline rollers into a multiband shade that is operated by one roller drive-end assembly.

F. Shadebands:

1. Shadeband Material:

a. Light-filtering fabric, 4 percent openness.

2. Shadeband Bottom (Hem) Bar: Steel or extruded aluminum.

a. Type: Enclosed in sealed pocket of shadeband material.

G. Installation Accessories:

1. Front Fascia: Aluminum extrusion, flush with wall above it, that conceals front and underside of roller and operating mechanism and attaches to roller endcaps without exposed fasteners. Cut fascia in field for jamb mounting.

a. Shape: L-shaped.
b. Height: Manufacturer's standard height required to conceal roller and shadeband when shade is fully open, but not less than 3 inches.
c. Enclosure Color: Custom color to match curtainwalls system. Submit for Architect’s approval.

2. Installation Accessories Color and Finish: As selected from manufacturer's full range.

2.3 MOTOR-OPERATED, SINGLE-ROLLER SHADES

A. Manufacturer:

1. Subject to compliance with requirements, provide products approved by Architect by one of the following:

a. Draper Inc.
b. Hunter Douglas Contract.
c. Lutron Electronics Co., Inc.
d. MechoShade Systems, Inc

B. Motorized Operating System: Provide factory-assembled, shade-operator system of size and capacity and with features, characteristics, and accessories suitable for conditions indicated,

complete with electric motor and factory-prewired motor controls, power disconnect switch, enclosures protecting controls and operating parts, and accessories required for reliable operation without malfunction. Include wiring from motor controls to motors. Coordinate operator wiring requirements and electrical characteristics with building electrical system.

1. Electrical Components: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
2. Electric Motor: Manufacturer's standard tubular, enclosed in roller.

    a. Basis of Design: Whisper Shade IQ2, or equal.
    b. Maximum Total Shade Width: As required to operate roller shades indicated.
    c. Maximum Shade Drop: As required to operate roller shades indicated.
    d. Maximum Weight Capacity: As required to operate roller shades indicated.

3. Remote Control: Electric controls with NEMA ICS 6, Type 1 enclosure for surface mounting. Provide the following for remote-control activation of shades:

    a. Group Control Station: Momentary-contact, three-position, rocker-style, wall-switch-operated control station with open, close, and center off functions for single-switch group control.
    b. Color: As selected by Architect from manufacturer's full range.

4. Crank-Operator Override: Crank and gearbox operate shades in event of power outage or motor failure.
5. Limit Switches: Adjustable switches interlocked with motor controls and set to stop shades automatically at fully raised and fully lowered positions.
6. Operating Features:

    a. Group switching with integrated switch control; single faceplate for multiple switch cutouts.
    b. Override switch.

C. Rollers: Corrosion-resistant steel or extruded-aluminum tubes of diameters and wall thicknesses required to accommodate operating mechanisms and weights and widths of shadebands indicated without deflection. Provide with permanently lubricated drive-end assemblies and idle-end assemblies designed to facilitate removal of shadebands for service.

1. Roller Drive-End Location: Right side of interior face of shade.
2. Direction of Shadeband Roll: Regular, from back (exterior face) of roller.
3. Shadeband-to-Roller Attachment: Manufacturer's standard method.

D. Mounting Hardware: Brackets or endcaps, corrosion resistant and compatible with roller assembly, operating mechanism, installation accessories, and mounting location and conditions indicated.

E. Roller-Coupling Assemblies: Coordinated with operating mechanism and designed to join up to three inline rollers that are operated by one roller drive-end assembly.

F. Shadebands:

1. Shadeband Material: Light-filtering fabric.
2. Shadeband Bottom (Hem) Bar: Steel or extruded aluminum.

    a. Type: Enclosed in sealed pocket of shadeband material.
    b. Color and Finish: As selected by Architect from manufacturer's full range.

G. Installation Accessories:

1. Front Fascia: Aluminum extrusion, flush with wall above it, that conceals front and underside of roller and operating mechanism and attaches to roller endcaps without exposed fasteners. Cut fascia in field for jamb mounting.

    a. Shape: L-shaped.
    b. Height: Manufacturer's standard height required to conceal roller and shadeband when shade is fully open, but not less than 3 inches.
    c. Enclosure Color: Custom color to match curtainwalls system. Submit for Architect’s approval.

2. Installation Accessories Color and Finish: As selected from manufacturer's full range.

2.4 SHADEBAND MATERIALS

A. Shadeband Material Flame-Resistance Rating: Comply with NFPA 701. Testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.

B. Light-Filtering Fabric: Woven fabric, stain and fade resistant.

1. Source: Roller shade manufacturer.
2. Type: PVC-coated fiberglass.
3. Weave: Mesh.
4. Orientation on Shadeband: As indicated on Drawings.
5. Openness Factor: 4 percent.
6. Color: As selected by Architect from manufacturer's full range.

2.5 ROLLER SHADE FABRICATION

A. Product Safety Standard: Fabricate roller shades to comply with WCMA A 100.1, including requirements for flexible, chain-loop devices; lead content of components; and warning labels.

B. Unit Sizes: Fabricate units in sizes to fill window and other openings as follows, measured at 74 deg F:

1. Outside of Jamb Installation: Width and length as indicated, with terminations between shades of end-to-end installations at centerlines of mullion or other defined vertical separations between openings.

C. Shadeband Fabrication: Fabricate shadebands without battens or seams to extent possible, except as follows:

1. Vertical Shades: Where width-to-length ratio of shadeband is equal to or greater than 1:4, provide battens and seams at uniform spacings along shadeband length to ensure shadeband tracking and alignment through its full range of movement without distortion of the material.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances, operational clearances, locations of connections to building electrical system, and other conditions affecting performance of the Work.

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

3.2 ROLLER SHADE INSTALLATION

A. Install roller shades level, plumb, and aligned with adjacent units according to manufacturer's written instructions.

B. Electrical Connections: Connect motor-operated roller shades to building electrical system.

C. Roller Shade Locations: At windows indicated.

3.3 ADJUSTING

A. Adjust and balance roller shades to operate smoothly, easily, safely, and free from binding or malfunction throughout entire operational range.

3.4 CLEANING AND PROTECTION

A. Clean roller shade surfaces, after installation, according to manufacturer's written instructions.

B. Provide final protection and maintain conditions, in a manner acceptable to manufacturer and Installer, that ensure that roller shades are without damage or deterioration at time of Substantial Completion.

C. Replace damaged roller shades that cannot be repaired, in a manner approved by Architect, before time of Substantial Completion.

3.5 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain motor-operated roller shades.

END OF SECTION 12 2413

SECTION 12 3623 - PLASTIC-LAMINATE-CLAD COUNTERTOPS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes

1. Plastic-laminate-clad countertops.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Shop Drawings: For plastic-laminate-clad countertops.

1. Include plans, sections, details, and attachments to other work. Detail fabrication and installation, including field joints.
2. Show locations and sizes of cutouts and holes for items installed in plastic-laminate-clad countertops.

C. Samples for Verification: As follows:

1. Wood-Grain Plastic Laminates: For each type, color, pattern, and surface finish required, 12 by 24 inches in size.
2. Fabrication Sample: For each type and profile of countertop required, provide one sample applied to core material with specified edge material applied to one edge.

1.3 INFORMATIONAL SUBMITTALS

A. Qualification Data: For Installer.

B. Product Certificates: For the following:

1. High-pressure decorative laminate.
2. Adhesives.

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.

1. Shop Certification: AWI's Quality Certification Program accredited participant.

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.

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: 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.

B. 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.

C. 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 FABRICATORS

2.2 PLASTIC-LAMINATE-CLAD COUNTERTOPS

A. Quality Standard: Unless otherwise indicated, comply with the "Architectural Woodwork Standards" 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 the referenced quality standard. Comply with requirements of Contract Documents in addition to those of the referenced quality standard.

B. Grade: Custom.

C. Certified Wood: Certify wood products as "FSC Pure" or "FSC Mixed Credit" in accordance with FSC STD-01-001 and FSC STD-40-004.

D. High-Pressure Decorative Laminate: NEMA LD 3, Grade HGP.

1. Basis of Design: Item M3 (Formica Corporation; 5487-26 – Oiled Walnut) as indicated on Finish Legend.

a. Subject to compliance with requirements provide basis of design product of an equivalent product from another manufacturer.

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 on Finish Legend.

F. Edge Treatment: Same as laminate cladding on horizontal surfaces.

1. Front Configuration: 3/4-inch bullnose.

G. Core Material: Either MDF made with exterior glue or exterior-grade plywood.

1. MDF Product: Medex.

H. Core Thickness: 3/4 inch.

1. Build up countertop thickness to 1-1/2 inches at front, back, and ends with additional layers of core material laminated to top.

I. Backer Sheet: Provide plastic-laminate backer sheet, NEMA LD 3, Grade BKL, on underside of countertop substrate.

J. Paper Backing: Provide paper backing on underside of countertop substrate.

2.3 WOOD MATERIALS

A. Wood Products: Provide materials that comply with requirements of referenced quality standard unless otherwise indicated.

1. Wood Moisture Content: 5 to 10 percent.

B. Composite Wood Products: Provide materials that comply with requirements of referenced quality standard for each type of countertop and quality grade specified unless otherwise indicated.

1. MDF: Medium-density fiberboard, ANSI A208.2, Grade 130.

2.4 MISCELLANEOUS MATERIALS

A. Installation Adhesive:

1. Verify adhesives have a VOC content of 70 g/L or less.

2.5 FABRICATION

A. 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.

B. 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 the dates and times countertop fabrication will be complete.

C. 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 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 PREPARATION

A. Before installation, condition countertops to average prevailing humidity conditions in installation areas.

B. Before installing countertops, examine shop-fabricated work for completion and complete work as required, including removal of packing.

3.2 INSTALLATION

A. Grade: Install countertops to comply with same grade as item to be installed.

B. Assemble countertops and complete fabrication at Project site to the extent that it was not completed in the shop.

1. Provide cutouts for appliances, plumbing fixtures, electrical work, and similar items. Locate openings accurately, and use templates or roughing-in diagrams to produce

accurately sized and shaped openings. Sand edges of cutouts to remove splinters and burrs.

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 shown 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 according to manufacturer's written instructions to exert a constant, heavy-clamping pressure at joints.

D. Scribe and cut countertops to fit adjoining work, refinish cut surfaces, and repair damaged finish at cuts.

E. Countertop Installation: Anchor securely by screwing through corner blocks of base cabinets or other supports into underside of countertop.

1. Install countertops level and true in line. Use concealed shims as required to maintain not more than a 1/8-inch-in-96-inches variation from a straight, level plane.
2. Provide backstops continuous with countertop.

3.3 ADJUSTING AND CLEANING

A. Repair damaged and defective countertops, where possible, to eliminate functional and visual defects. Where not possible to repair, replace countertops. Adjust joinery for uniform appearance.

B. Clean countertops on exposed and semiexposed surfaces.

C. 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 3623

SECTION 12 3662 - SOLID SURFACING COUNTERTOPS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Solid surface material countertops.

1.2 ACTION SUBMITTALS

A. Product Data: For countertop materials.

B. Shop Drawings: For countertops. Show materials, finishes, edge profiles, methods of joining, and cutouts.

1. Show locations and details of joints.
2. Show direction of directional pattern, if any.

C. Samples for Verification: For the following products:

1. Countertop material, 6 inches square.
2. One full-size solid surface material countertop, with front edge, 8 by 10 inches, of construction and in configuration specified.

1.3 INFORMATIONAL SUBMITTALS

A. Qualification Data: For fabricator.

1.4 CLOSEOUT SUBMITTALS

A. Maintenance Data: For solid surface material countertops to include in maintenance manuals. Include Product Data for care products used or recommended by Installer and names, addresses, and telephone numbers of local sources for products.

1.5 QUALITY ASSURANCE

A. Fabricator Qualifications: Shop that employs skilled workers who custom-fabricate countertops similar to that required for this Project, and whose products have a record of successful in-service performance.

B. Installer Qualifications: Fabricator of countertops.

C. Mockups: Build mockups to demonstrate aesthetic effects and to set quality standards for fabrication and execution.

1. Build mockup of typical countertop as shown on Drawings.
2. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.6 FIELD CONDITIONS

A. Field Measurements: Verify dimensions of countertops by field measurements after base cabinets are installed but before countertop fabrication is complete.

1.7 COORDINATION

A. Coordinate locations of utilities that will penetrate countertops.

PART 2 - PRODUCTS

2.1 SOLID SURFACE COUNTERTOP MATERIALS

A. Solid Surface Material: Homogeneous-filled plastic resin complying with ICPA SS-1.

1. Basis of Design: Item M2 (LG Hausys; Hi-Macs – M103 Firenze) as indicated on Finish Legend.

a. Subject to compliance with requirements provide basis of design product of an equivalent product from another manufacturer:

2. Colors and Patterns: As indicated on Finish Legend.
3. Type: Provide Standard type or Veneer type made from material complying with requirements for Standard type, as indicated unless Special Purpose type is indicated.
4. Colors and Patterns: As indicated on finish Schedule.

B. Plywood: Exterior softwood plywood complying with DOC PS 1, Grade C-C Plugged, touch sanded.

2.2 COUNTERTOP FABRICATION

A. Fabricate countertops according to solid surface material manufacturer's written instructions and to the AWI/AWMAC/WI's "Architectural Woodwork Standards."

1. Grade: Custom.

B. Configuration:

1. Front: Straight, slightly eased at top.

C. Countertops: 1/2-inch- thick, solid surface material with front edge built up with same material.

D. Fabricate tops with shop-applied edges unless otherwise indicated. Comply with solid surface material manufacturer's written instructions for adhesives, sealers, fabrication, and finishing.

E. Joints: Fabricate countertops without joints.

2.3 INSTALLATION MATERIALS

A. Adhesive: Product recommended by solid surface material manufacturer.

1. Verify adhesives have a VOC content of 70 g/L or less.

B. Sealant for Countertops: Comply with applicable requirements in Section 07 9200 "Joint Sealants."

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates to receive solid surface material 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 INSTALLATION

A. Install countertops level to a tolerance of 1/8 inch in 8 feet, 1/4 inch maximum. Do not exceed 1/64-inch difference between planes of adjacent units.

B. Fasten countertops by screwing through corner blocks of base units into underside of countertop. Predrill holes for screws as recommended by manufacturer. Align adjacent surfaces and, using adhesive in color to match countertop, form seams to comply with manufacturer's written instructions. Carefully dress joints smooth, remove surface scratches, and clean entire surface.

C. Fasten subtops to cabinets by screwing through subtops into cornerblocks of base cabinets. Shim as needed to align subtops in a level plane.

D. Secure countertops to subtops with adhesive according to solid surface material manufacturer's written instructions. Align adjacent surfaces and, using adhesive in color to match countertop, form seams to comply with manufacturer's written instructions. Carefully dress joints smooth, remove surface scratches, and clean entire surface.

E. Bond joints with adhesive and draw tight as countertops are set. Mask areas of countertops adjacent to joints to prevent adhesive smears.

1. Install metal splines in kerfs in countertop edges at joints where indicated. Fill kerfs with adhesive before inserting splines and remove excess immediately after adjoining units are drawn into position.
2. Clamp units to temporary bracing, supports, or each other to ensure that countertops are properly aligned and joints are of specified width.

F. Complete cutouts not finished in shop. Mask areas of countertops adjacent to cutouts to prevent damage while cutting. Make cutouts to accurately fit items to be installed, and at right angles to finished surfaces unless beveling is required for clearance. Ease edges slightly to prevent snipping.

G. Apply sealant to gaps at walls; comply with Section 07 9200 "Joint Sealants."

END OF SECTION 12 3662

SECTION 12 3663 - QUARTZ AGGLOMERATE COUNTERTOPS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Quartz agglomerate countertops.
2. Quartz agglomerate backsplashes.
3. Quartz agglomerate end splashes.

B. Related Requirements:

1. Section 22 4100 "Residential Plumbing Fixtures" for sinks and plumbing fittings.

1.2 ACTION SUBMITTALS

A. Product Data: For countertop materials.

B. Shop Drawings: For countertops. Show materials, finishes, edge and backsplash profiles, methods of joining, and cutouts for plumbing fixtures.

1. Show locations and details of joints.
2. Show direction of directional pattern, if any.

C. Samples for Verification: For the following products:

1. Countertop material, 6 inches square.
2. One full-size quartz agglomerate countertop, with front edge and backsplash, 8 by 10 inches, of construction and in configuration specified.

1.3 INFORMATIONAL SUBMITTALS

A. Qualification Data: For fabricator.

1.4 CLOSEOUT SUBMITTALS

A. Maintenance Data: For quartz agglomerate countertops to include in maintenance manuals. Include Product Data for care products used or recommended by Installer and names, addresses, and telephone numbers of local sources for products.

1.5 QUALITY ASSURANCE

A. Fabricator Qualifications: Shop that employs skilled workers who custom-fabricate countertops similar to that required for this Project, and whose products have a record of successful in-service performance.

B. Installer Qualifications: Fabricator of countertops.

C. Mockups: Build mockups to demonstrate aesthetic effects and to set quality standards for fabrication and execution.

1. Build mockup of typical countertop as shown on Drawings.
2. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.6 FIELD CONDITIONS

A. Field Measurements: Verify dimensions of countertops by field measurements after base cabinets are installed but before countertop fabrication is complete.

1.7 COORDINATION

A. Coordinate locations of utilities that will penetrate countertops or backsplashes.

PART 2 - PRODUCTS

2.1 QUARTZ AGGLOMERATE COUNTERTOP MATERIALS

A. Quartz Agglomerate: Solid sheets consisting of quartz aggregates bound together with a matrix of filled plastic resin and complying with ICPA SS-1, except for composition.

1. Basis of Design: Item M4 (Cambria; Ridgegate) as indicated on Finish Legend.

a. Subject to compliance with requirements provide basis of design product of an equivalent product from another manufacturer:

2. Colors and Patterns: As indicated on Finish Legend.

B. Plywood: Exterior softwood plywood complying with DOC PS 1, Grade C-C Plugged, touch sanded.

2.2 COUNTERTOP FABRICATION

A. Fabricate countertops according to quartz agglomerate manufacturer's written instructions and the AWI/AWMAC/WI's "Architectural Woodwork Standards."

1. Grade: Custom.

B. Configuration:

1. Front: Straight, slightly eased at top.
2. Backsplash: Straight, slightly eased at corner.
3. End Splash: Matching backsplash.

C. Countertops: 1/2-inch- thick, quartz agglomerate with front edge built up with same material.

D. Backsplashes: 1/2-inch- thick, quartz agglomerate.

E. Fabricate tops with shop-applied edges and backsplashes unless otherwise indicated. Comply with quartz agglomerate manufacturer's written instructions for adhesives, sealers, fabrication, and finishing.

1. Fabricate with loose backsplashes for field assembly.

F. Joints: Fabricate countertops without joints.

G. Cutouts and Holes:

1. Undercounter Plumbing Fixtures: Make cutouts for fixtures in shop using template or pattern furnished by fixture manufacturer. Form cutouts to smooth, even curves.

a. Provide vertical edges, slightly eased at juncture of cutout edges with top and bottom surfaces of countertop and projecting 3/16 inch into fixture opening.

2. Fittings: Drill countertops in shop for plumbing fittings, undercounter soap dispensers, and similar items.

2.3 INSTALLATION MATERIALS

A. Adhesive: Product recommended by quartz agglomerate manufacturer.

1. Verify adhesives have a VOC content of 70 g/L or less.

B. Sealant for Countertops: Comply with applicable requirements in Section 07 9200 "Joint Sealants."

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates to receive quartz agglomerate 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 INSTALLATION

A. Install countertops level to a tolerance of 1/8 inch in 8 feet, 1/4 inch maximum. Do not exceed 1/64-inch difference between planes of adjacent units.

B. Fasten countertops by screwing through corner blocks of base units into underside of countertop. Predrill holes for screws as recommended by manufacturer. Align adjacent surfaces and, using adhesive in color to match countertop, form seams to comply with quartz agglomerate manufacturer's written instructions. Carefully dress joints smooth, remove surface scratches, and clean entire surface.

C. Fasten subtops to cabinets by screwing through subtops into cornerblocks of base cabinets. Shim as needed to align subtops in a level plane.

D. Secure countertops to subtops with adhesive according to quartz agglomerate manufacturer's written instructions. Align adjacent surfaces and, using adhesive in color to match countertop, form seams to comply with quartz agglomerate manufacturer's written instructions. Carefully dress joints smooth, remove surface scratches, and clean entire surface.

E. Bond joints with adhesive and draw tight as countertops are set. Mask areas of countertops adjacent to joints to prevent adhesive smears.

1. Install metal splines in kerfs in countertop edges at joints where indicated. Fill kerfs with adhesive before inserting splines and remove excess immediately after adjoining units are drawn into position.
2. Clamp units to temporary bracing, supports, or each other to ensure that countertops are properly aligned and joints are of specified width.

F. Install backsplashes and end splashes by adhering to wall and countertops with adhesive. Mask areas of countertops and splashes adjacent to joints to prevent adhesive smears.

G. Install aprons to backing and countertops with adhesive. Mask areas of countertops and splashes adjacent to joints to prevent adhesive smears. Fasten by screwing through backing. Predrill holes for screws as recommended by manufacturer.

H. Complete cutouts not finished in shop. Mask areas of countertops adjacent to cutouts to prevent damage while cutting. Make cutouts to accurately fit items to be installed, and at right angles to finished surfaces unless beveling is required for clearance. Ease edges slightly to prevent snipping.

I. Apply sealant to gaps at walls; comply with Section 07 9200 "Joint Sealants."

END OF SECTION 12 3663

SECTION 22 0500 - COMMON WORK RESULTS FOR PLUMBING

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Furnish all labor, materials, equipment, tools and services required to fully complete all Plumbing work as is indicated on the drawings and/or specified herein including, but not limited to, the following described items.
   1. Piping materials and installation instructions common to most piping systems.
   2. Transition fittings.
   3. Dielectric fittings.
   4. Escutcheons.
   5. Grout.
   6. Equipment installation requirements common to equipment sections.
   7. Painting and finishing.
   8. Concrete bases.
   9. Supports and anchorages.

1.02 SEISMIC REQUIREMENTS

A. Seismic Performance: Equipment, pipe hangers and supports shall withstand the effects of earthquake motions determined according to SEI/ASCE 7 and with the requirements specified in Section 22 0548 " Vibration and Seismic Controls for Plumbing Piping and Equipment.
   1. For components with a seismic importance factor of 1.0 the term "withstand" means "the system will remain in place without separation of any parts when subjected to the seismic forces specified."
   2. For components with a seismic importance factor of 1.5 the term "withstand" means "the system will remain in place without separation of any parts when subjected to the seismic forces specified and the system will be fully operational after the seismic event."

1.03 DEFINITIONS

A. Finished Spaces: Spaces other than mechanical and electrical equipment rooms, furred spaces, pipe chases, unheated spaces immediately below roof, spaces above ceilings, unexcavated spaces, and crawlspaces.
B. Exposed, Interior Installations: Exposed to view indoors. Examples include finished occupied spaces and mechanical equipment rooms, accessible pipe shafts, accessible plumbing chases and accessible tunnels.
C. Exposed, Exterior Installations: Exposed to view outdoors or subject to outdoor ambient temperatures and weather conditions. Examples include rooftop locations.
D. Concealed, Interior Installations: Concealed from view and protected from physical contact by building occupants. Examples include above ceilings and in chases.

E. Concealed, Exterior Installations: Concealed from view and protected from weather conditions and physical contact by building occupants but subject to outdoor ambient temperatures. Examples include installations within unheated shelters.
F. The following are industry abbreviations for rubber materials:
   1. EPDM: Ethylene-propylene-diene terpolymer rubber.
   2. NBR: Acrylonitrile-butadiene rubber.

1.04 SUBMITTALS

A. Product Data: For the following:
   1. Transition fittings.
   2. Dielectric fittings.
   3. Mechanical sleeve seals.
   4. Escutcheons.
B. Welding certificates.

1.05 QUALITY ASSURANCE

A. Steel Support Welding: Qualify processes and operators according to AWS D1.1, "Structural Welding Code--Steel."
B. Electrical Characteristics for Plumbing Equipment: Equipment of higher electrical characteristics may be furnished provided such proposed equipment is approved in writing and connecting electrical services, circuit breakers, and conduit sizes are appropriately modified. If minimum energy ratings or efficiencies are specified, equipment shall comply with requirements.

1.06 DELIVERY, STORAGE, AND HANDLING

A. Deliver pipes and tubes with factory-applied end caps. Maintain end caps through shipping, storage, and handling to prevent pipe end damage and to prevent entrance of dirt, debris, and moisture.
B. Store plastic pipes protected from direct sunlight. Support to prevent sagging and bending.

1.07 COORDINATION

A. Arrange for pipe spaces, chases, slots, and openings in building structure during progress of construction, to allow for plumbing installations.
B. Coordinate installation of required supporting devices and set sleeves in poured-in-place concrete and other structural components as they are constructed.
C. Coordinate requirements for access panels and doors for plumbing items requiring access that are concealed behind finished surfaces. Access panels and doors are specified in Division 08 Section "Access Doors and Frames."
D. The Mechanical Contractor shall work under the Contractor to assemble all trade coordination drawings (info.) and compile them into a single BIM model. The purpose of this model shall be to coordinate all applicable trade components and resolve conflicts prior to procurement / fabrication / installation. Refer to specifications for further requirements.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. In other Part 2 articles where subparagraph titles below introduce lists, the following requirements apply for product selection:
   1. Manufacturers: Subject to compliance with requirements, provide products by the manufacturers specified.

2.02 PIPE, TUBE, AND FITTINGS

A. Refer to individual Division 22 piping Sections for pipe, tube, and fitting materials and joining methods.
B. Pipe Threads: ASME B1.20.1 for factory-threaded pipe and pipe fittings.

2.03 JOINING MATERIALS

A. Refer to individual Division 22 piping Sections for special joining materials not listed below.
B. Pipe-Flange Gasket Materials: Suitable for chemical and thermal conditions of piping system contents.
   1. ASME B16.21, nonmetallic, flat, asbestos-free, 1/8-inch maximum thickness unless thickness or specific material is indicated.
      a. Full-Face Type: For flat-face, Class 125, cast-iron and cast-bronze flanges.
      b. Narrow-Face Type: For raised-face, Class 250, cast-iron and steel flanges.
   2. AWWA C110, rubber, flat face, 1/8 inch thick, unless otherwise indicated; and full-face or ring type, unless otherwise indicated.
C. Flange Bolts and Nuts: , ASME B1.20.1, carbon steel, unless otherwise indicated.
D. Plastic, Pipe-Flange Gasket, Bolts, and Nuts: Type and material recommended by piping system manufacturer, unless otherwise indicated.
E. Solder Filler Metals: ASTM B 32, lead-free alloys. Include water-flushable flux according to ASTM B 813.
F. Brazing Filler Metals: AWS A5.8, BCuP Series, copper-phosphorus alloys for general-duty brazing, unless otherwise indicated; and AWS A5.8, BAg1, silver alloy for refrigerant piping, unless otherwise indicated.

2.04 TRANSITION FITTINGS

A. Flexible Transition Couplings for Underground Nonpressure Drainage Piping: ASTM C 1173 with elastomeric sleeve, ends same size as piping to be joined, and corrosion-resistant metal band on each end.
   1. Manufacturers:
      a. Cascade Waterworks Mfg. Co.
      b. Fernco, Inc.
      c. Mission Rubber Company.
      d. Plastic Oddities, Inc.

2.05 DIELECTRIC FITTINGS

A. Description: Combination fitting of copper alloy and ferrous materials with threaded, solder-joint, plain, or weld-neck end connections that match piping system materials.
B. Insulating Material: Suitable for system fluid, pressure, and temperature.
C. Dielectric Unions: Factory-fabricated, union assembly, for 250-psig minimum working pressure at 180 deg F.
    1. Manufacturers:
        a. Capitol Manufacturing Co.
        b. Hart Industries, International, Inc.
        c. Watts Industries, Inc.; Water Products Div.
        d. Zurn Industries, Inc.; Wilkins Div.
D. Dielectric Flanges: Factory-fabricated, companion-flange assembly, for 150- or 300-psig minimum working pressure as required to suit system pressures.
    1. Manufacturers:
        a. Capitol Manufacturing Co.
        b. Watts Industries, Inc.; Water Products Div.
E. Dielectric-Flange Kits: Companion-flange assembly for field assembly. Include flanges, full-face- or ring-type neoprene or phenolic gasket, phenolic or polyethylene bolt sleeves, phenolic washers, and steel backing washers.
    1. Manufacturers:
        a. Advance Products & Systems, Inc.
        b. Calpico, Inc.
        c. Pipeline Seal and Insulator, Inc.
    2. Separate companion flanges and steel bolts and nuts shall have 150- or 300-psig minimum working pressure where required to suit system pressures.
F. Dielectric Couplings: Galvanized-steel coupling with inert and noncorrosive, thermoplastic lining; threaded ends; and 300-psig minimum working pressure at 225 deg F.
    1. Manufacturers:
        a. Calpico, Inc.
        b. Lochinvar Corp.
G. Dielectric Nipples: Electroplated steel nipple with inert and noncorrosive, thermoplastic lining; plain, threaded, or grooved ends; and 300-psig minimum working pressure at 225 deg F.
    1. Manufacturers:
        a. Perfection Corp.
        b. Precision Plumbing Products, Inc.
        c. Sioux Chief Manufacturing Co., Inc.
        d. Victaulic Co. of America.

2.06 GROUT

A. Description: ASTM C 1107, Grade B, nonshrink and nonmetallic, dry hydraulic-cement grout.
    1. Characteristics: Post-hardening, volume-adjusting, nonstaining, noncorrosive, nongaseous, and recommended for interior and exterior applications.

2. Design Mix: 5000-psi, 28-day compressive strength.
3. Packaging: Premixed and factory packaged.

PART 3 EXECUTION

3.01 SEISMIC REQUIREMENTS

A. Comply with SEI/ASCE 7 and with requirements for seismic seismic-restraint devices in Section 220548 "Vibration and Seismic Controls for Plumbing Piping and Equipment."

3.02 PIPING SYSTEMS - COMMON REQUIREMENTS

A. Install piping according to the following requirements and Division 22 Sections specifying piping systems.
B. Drawing plans, schematics, and diagrams indicate general location and arrangement of piping systems. Indicated locations and arrangements were used to size pipe and calculate friction loss, expansion, pump sizing, and other design considerations. Install piping as indicated unless deviations to layout are approved on Coordination Drawings.
C. Install piping in concealed locations, unless otherwise indicated and except in equipment rooms and service areas.
D. Install piping indicated to be exposed and piping in equipment rooms and service areas at right angles or parallel to building walls. Diagonal runs are prohibited unless specifically indicated otherwise.
E. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal.
F. Install piping to permit valve servicing.
G. Install piping at indicated slopes.
H. Install piping free of sags and bends.
I. Install fittings for changes in direction and branch connections.
J. Install piping to allow application of insulation.
K. Select system components with pressure rating equal to or greater than system operating pressure.
L. Install escutcheons for penetrations of walls, ceilings, and floors according to the following:
    1. New Piping:
        a. Piping with Fitting or Sleeve Protruding from Wall: One-piece, deep-pattern type.
        b. Chrome-Plated Piping: One-piece, cast-brass type with polished chrome-plated finish.
        c. Insulated Piping: One-piece, stamped-steel type with spring clips.
        d. Bare Piping at Wall and Floor Penetrations in Finished Spaces: One-piece, cast-brass type with polished chrome-plated finish.
        e. Bare Piping at Wall and Floor Penetrations in Finished Spaces: One-piece, stamped-steel type.
        f. Bare Piping at Floor Penetrations in Equipment Rooms: One-piece, floor-plate type.
    2. Existing Piping: Use the following:
        a. Chrome-Plated Piping: Split-casting, cast-brass type with chrome-plated finish.

b. Bare Piping at Wall and Floor Penetrations in Finished Spaces: Split-casting, cast-brass type with chrome-plated finish.
c. Bare Piping at Wall and Floor Penetrations in Finished Spaces: Split-plate, stamped-steel type with concealed hinge and spring clips.
d. Bare Piping at Ceiling Penetrations in Finished Spaces: Split-casting, cast-brass type with chrome-plated finish.
e. Bare Piping at Ceiling Penetrations in Finished Spaces: Split-plate, stamped-steel type with concealed hinge and set screw.
f. Bare Piping in Equipment Rooms: Split-casting, cast-brass type.
g. Bare Piping in Equipment Rooms: Split-plate, stamped-steel type with set screw or spring clips.
h. Bare Piping at Floor Penetrations in Equipment Rooms: Split-casting, floor-plate type.

M. Sleeves are not required for core-drilled holes.
N. Install sleeves for pipes passing through concrete and masonry walls and concrete floor and roof slabs.
O. Install sleeves for pipes passing through concrete and masonry walls, gypsum-board partitions, and concrete floor and roof slabs.
1. Cut sleeves to length for mounting flush with both surfaces.
a. Exception: Extend sleeves installed in floors of mechanical equipment areas or other wet areas 2 inches above finished floor level. Extend cast-iron sleeve fittings below floor slab as required to secure clamping ring if ring is specified.
2. Install sleeves in new walls and slabs as new walls and slabs are constructed.
3. Install sleeves that are large enough to provide 1/4-inch annular clear space between sleeve and pipe or pipe insulation. Use the following sleeve materials:
a. Steel Pipe Sleeves: For pipes smaller than NPS 6.
b. Steel Sheet Sleeves: For pipes NPS 6 and larger, penetrating gypsum-board partitions.
c. Stack Sleeve Fittings: For pipes penetrating floors with membrane waterproofing. Secure flashing between clamping flanges. Install section of cast-iron soil pipe to extend sleeve to 2 inches above finished floor level. Refer to Division 07 Section "Sheet Metal Flashing and Trim" for flashing.
1) Seal space outside of sleeve fittings with grout.
4. Except for underground wall penetrations, seal annular space between sleeve and pipe or pipe insulation, using joint sealants appropriate for size, depth, and location of joint. Refer to Division 07 Section "Joint Sealants" for materials and installation.

P. Above ground, Exterior-Wall Pipe Penetrations: Seal penetrations using sleeves and mechanical sleeve seals. Select sleeve size to allow for 1-inch annular clear space between pipe and sleeve for installing mechanical sleeve seals.
1. Install steel pipe for sleeves smaller than 6 inches in diameter.
2. Install cast-iron "wall pipes" for sleeves 6 inches and larger in diameter.

3. Mechanical Sleeve Seal Installation: Select type and number of sealing elements required for pipe material and size. Position pipe in center of sleeve. Assemble mechanical sleeve seals and install in annular space between pipe and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make watertight seal.

Q. Underground, Exterior-Wall Pipe Penetrations: Install cast-iron "wall pipes" for sleeves. Seal pipe penetrations using mechanical sleeve seals. Select sleeve size to allow for 1-inch annular clear space between pipe and sleeve for installing mechanical sleeve seals.
1. Mechanical Sleeve Seal Installation: Select type and number of sealing elements required for pipe material and size. Position pipe in center of sleeve. Assemble mechanical sleeve seals and install in annular space between pipe and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make watertight seal.

R. Fire-Barrier Penetrations: Maintain indicated fire rating of walls, partitions, ceilings, and floors at pipe penetrations. Seal pipe penetrations with firestop materials. Refer to Division 07 Section "Penetration Firestopping" for materials.

S. Verify final equipment locations for roughing-in.

T. Refer to equipment specifications in other Sections of these Specifications for roughing-in requirements.

3.03 PIPING JOINT CONSTRUCTION

A. Join pipe and fittings according to the following requirements and Division 22 Sections specifying piping systems.

B. Ream ends of pipes and tubes and remove burrs. Bevel plain ends of steel pipe.

C. Remove scale, slag, dirt, and debris from inside and outside of pipe and fittings before assembly.

D. Soldered Joints: Apply ASTM B 813, water-flushable flux, unless otherwise indicated, to tube end. Construct joints according to ASTM B 828 or CDA's "Copper Tube Handbook," using lead-free solder alloy complying with ASTM B 32.

E. Brazed Joints: Construct joints according to AWS's "Brazing Handbook," "Pipe and Tube" Chapter, using copper-phosphorus brazing filler metal complying with AWS A5.8.

F. Threaded Joints: Thread pipe with tapered pipe threads according to ASME B1.20.1. Cut threads full and clean using sharp dies. Ream threaded pipe ends to remove burrs and restore full ID. Join pipe fittings and valves as follows:
1. Apply appropriate tape or thread compound to external pipe threads unless dry seal threading is specified.
2. Damaged Threads: Do not use pipe or pipe fittings with threads that are corroded or damaged. Do not use pipe sections that have cracked or open welds.

G. Welded Joints: Construct joints according to AWS D10.12, using qualified processes and welding operators according to Part 1 "Quality Assurance" Article.

H. Flanged Joints: Select appropriate gasket material, size, type, and thickness for service application. Install gasket concentrically positioned. Use suitable lubricants on bolt threads.

3.04 PIPING CONNECTIONS

A. Make connections according to the following, unless otherwise indicated:
   1. Install unions, in piping NPS 2 and smaller, adjacent to each valve and at final connection to each piece of equipment.
   2. Install flanges, in piping NPS 2-1/2 and larger, adjacent to flanged valves and at final connection to each piece of equipment.
   3. Dry Piping Systems: Install dielectric unions and flanges to connect piping materials of dissimilar metals.
   4. Wet Piping Systems: Install dielectric coupling and nipple fittings to connect piping materials of dissimilar metals.

3.05 EQUIPMENT INSTALLATION - COMMON REQUIREMENTS

A. Install equipment to allow maximum possible headroom unless specific mounting heights are not indicated.
B. Install equipment level and plumb, parallel and perpendicular to other building systems and components in exposed interior spaces, unless otherwise indicated.
C. Install plumbing equipment to facilitate service, maintenance, and repair or replacement of components. Connect equipment for ease of disconnecting, with minimum interference to other installations. Extend grease fittings to accessible locations.
D. Install equipment to allow right of way for piping installed at required slope.

3.06 CONCRETE BASES

A. Concrete Bases: Anchor equipment to concrete base according to equipment manufacturer's written instructions and according to seismic codes at Project.
   1. Construct concrete bases of dimensions indicated, but not less than 4 inches larger in both directions than supported unit.
   2. 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 the base.
   3. Install epoxy-coated anchor bolts for supported equipment that extend through concrete base, and anchor into structural concrete floor.
   4. Place and secure anchorage devices. Use supported equipment manufacturer's setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
   5. Install anchor bolts to elevations required for proper attachment to supported equipment.
   6. Install anchor bolts according to anchor-bolt manufacturer's written instructions.

3.07 ERECTION OF METAL SUPPORTS AND ANCHORAGES

A. Refer to Division 05 Section "Metal Fabrications" for structural steel.
B. Cut, fit, and place miscellaneous metal supports accurately in location, alignment, and elevation to support and anchor plumbing materials and equipment.
C. Field Welding: Comply with AWS D1.1.

3.08 GROUTING

A. Mix and install grout for plumbing equipment base bearing surfaces, pump and other equipment base plates, and anchors.
B. Clean surfaces that will come into contact with grout.
C. Provide forms as required for placement of grout.
D. Avoid air entrapment during placement of grout.
E. Place grout, completely filling equipment bases.
F. Place grout on concrete bases and provide smooth bearing surface for equipment.
G. Place grout around anchors.
H. Cure placed grout.

END OF SECTION 22 0500

SECTION 22 0517 - SLEEVES AND SLEEVE SEALS FOR PLUMBING PIPING

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Furnish all labor, materials, equipment, tools and services required to fully complete all Sleeve and Seal work as is indicated on the drawings and/or specified herein including, but not limited to, the following described items.
   1. Sleeves.
   2. Sleeve-seal systems.
   3. Grout.

1.02 ACTION SUBMITTALS

A. Product Data: For each type of product indicated.

PART 2 PRODUCTS

2.01 SLEEVES

A. Cast-Iron Wall Pipes: Cast or fabricated of cast or ductile iron and equivalent to ductile-iron pressure pipe, with plain ends and integral water stop unless otherwise indicated.
B. Galvanized-Steel Wall Pipes: ASTM A 53, Schedule 40, with plain ends and welded steel collar; zinc coated.
C. Galvanized-Steel-Pipe Sleeves: ASTM A 53, Type E, Grade B, Schedule 40, zinc coated, with plain ends.
D. Galvanized-Steel-Sheet Sleeves: 0.0239-inch minimum thickness; round tube closed with welded longitudinal joint.

2.02 SLEEVE-SEAL SYSTEMS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   1. Advance Products & Systems, Inc.
   2. CALPICO, Inc.
   3. Metraflex Company (The).
   4. Pipeline Seal and Insulator, Inc.
   5. Proco Products, Inc.
   6. Link Seal.
B. Description: Modular sealing-element unit, designed for field assembly, for filling annular space between piping and sleeve.
   1. Sealing Elements: EPDM-rubber interlocking links shaped to fit surface of pipe. Include type and number required for pipe material and size of pipe.
   2. Pressure Plates: Stainless steel. Include two for each sealing element.
      a. Modular seal pressure plates shall be molded of glass reinforced Nylon Polymer with the following properties:

1) Izod Impact - Notched = 2.05ft-lb/in. per ASTM D-256
2) Flexural Strength @ Yield = 30,750 psi per ASTM D-790
3) Flexural Modulus = 1,124,000 psi per ASTM D-790
4) Elongation Break = 11.07% per ASTM D-638
5) Specific Gravity = 1.38 per ASTM D-792

3. Connecting Bolts and Nuts: 316 Stainless Steel per ASTM F593-95, with an 85,000-psi average tensile strength. Length as required to secure pressure plates to sealing elements.

2.03 SLEEVE-SEAL FITTINGS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
B. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   1. GPT Industries WSG
C. Description: Manufactured galvanized steel sleeve with water stop assembly made for embedding in concrete slab or wall. Sleeve size through 10” shall be Schedule 40 steel pipe or standard wall thickness. Sleeve sizes 12 and larger shall have a 0.375 inch or standard wall thickness. 2” steel water stop collar. Water stop collar shall be of the same steel as the sleeve. The collar shall be welded all around on both sides to the sleeve at the point in the sleeve that positions it at mid-point of the wall when the sleeve is in place. Sleeve with water stop shall be galvanized inside and outside.

2.04 GROUT

A. Standard: ASTM C 1107, Grade B, post-hardening and volume-adjusting, dry, hydraulic-cement grout.
B. Characteristics: Nonshrink; recommended for interior and exterior applications.
C. Design Mix: 5000-psi, 28-day compressive strength.
D. Packaging: Premixed and factory packaged.

PART 3 EXECUTION

3.01 SLEEVE INSTALLATION

A. Install sleeves for piping passing through penetrations in floors, partitions, roofs, and walls.
B. For sleeves that will have sleeve-seal system installed, select sleeves of size large enough to provide 1-inch annular clear space between piping and concrete slabs and walls.
   1. Sleeves are not required for core-drilled holes.
C. Install sleeves in concrete floors, concrete roof slabs, and concrete walls as new slabs and walls are constructed.
   1. Permanent sleeves are not required for holes in slabs formed by molded-PE or -PP sleeves.
   2. Cut sleeves to length for mounting flush with both surfaces.
      a. Exception: Extend sleeves installed in floors of mechanical equipment areas or other wet areas 2 inches above finished floor level.

3. Using grout, seal the space outside of sleeves in slabs and walls without sleeve-seal system.

D. Install sleeves for pipes passing through interior partitions.
   1. Cut sleeves to length for mounting flush with both surfaces.
   2. Install sleeves that are large enough to provide 1/4-inch annular clear space between sleeve and pipe or pipe insulation.
   3. Seal annular space between sleeve and piping or piping insulation; use joint sealants appropriate for size, depth, and location of joint. Comply with requirements for sealants specified in Division 07 Section "Joint Sealants."
   4. For sound-rated partitions, fill the opening between sleeve and piping with insulation prior to sealing.

E. Fire-Barrier Penetrations: Maintain indicated fire rating of walls, partitions, ceilings, and floors at pipe penetrations. Seal pipe penetrations with firestop materials. Comply with requirements for firestopping specified in Division 07 Section "Penetration Firestopping."

3.02 SLEEVE-SEAL-SYSTEM INSTALLATION

A. Install sleeve-seal systems in sleeves in exterior concrete walls and slabs-on-grade at service piping entries into building.

B. Select type, size, and number of sealing elements required for piping material and size and for sleeve ID or hole size. Position piping in center of sleeve. Center piping in penetration, assemble sleeve-seal system components, and install in annular space between piping and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make a watertight seal.

3.03 SLEEVE AND SLEEVE-SEAL SCHEDULE

A. Use sleeves and sleeve seals for the following piping-penetration applications:
   1. Exterior Concrete Walls above Grade:
      a. Piping Smaller Than NPS 6: Cast-iron wall sleeves.
   2. Exterior Concrete Walls below Grade:
      a. Piping Smaller Than NPS 6: Cast-iron wall sleeves with sleeve-seal system.
         1) Select sleeve size to allow for 1-inch annular clear space between piping and sleeve for installing sleeve-seal system.
      b. Piping NPS 6 and Larger: Cast-iron wall sleeves with sleeve-seal system.
         1) Select sleeve size to allow for 1-inch annular clear space between piping and sleeve for installing sleeve-seal system.
   3. Concrete Slabs above Grade:
      a. Piping Smaller Than NPS 6: Galvanized-steel-pipe sleeves.
   4. Interior Partitions:
      a. Piping Smaller Than NPS 6: Galvanized-steel-pipe sleeves.

END OF SECTION 22 0517

SECTION 22 0523 - GENERAL - DUTY VALVES FOR PLUMBING PIPING

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Furnish all labor, materials, equipment, tools and services required to fully complete all Valve work as is indicated on the drawings and/or specified herein including, but not limited to, the following described items.
   1. Bronze angle valves.
   2. Bronze ball valves.
   3. Bronze lift check valves.
   4. Bronze swing check valves.
   5. Iron swing check valves.

1.02 RELATED REQUIREMENTS

A. Division 22 plumbing piping Sections for specialty valves applicable to those Sections only.
B. Division 22 Section "Identification for Plumbing Piping and Equipment" for valve tags and schedules.
C. Division 33 water distribution piping Sections for general-duty and specialty valves for site construction piping.

1.03 DEFINITIONS

A. CWP: Cold working pressure.
B. EPDM: Ethylene propylene copolymer rubber.
C. NBR: Acrylonitrile-butadiene, Buna-N, or nitrile rubber.
D. NRS: Non rising stem.
E. OS&Y: Outside screw and yoke.
F. RS: Rising stem.
G. SWP: Steam working pressure.

1.04 SUBMITTALS

A. Product Data: For each type of valve indicated.

1.05 QUALITY ASSURANCE

A. Source Limitations for Valves: Obtain each type of valve from single source from single manufacturer.
B. ASME Compliance:
   1. ASME B16.10 and ASME B16.34 for ferrous valve dimensions and design criteria.
   2. ASME B31.1 for power piping valves.
   3. ASME B31.9 for building services piping valves.
C. NSF Compliance: NSF 61 for valve materials for potable-water service.

1.06 DELIVERY, STORAGE, AND HANDLING

A. Prepare valves for shipping as follows:
   1. Protect internal parts against rust and corrosion.
   2. Protect threads, flange faces, grooves, and weld ends.
   3. Set angle, gate, and globe valves closed to prevent rattling.
   4. Set ball and plug valves open to minimize exposure of functional surfaces.
   5. Block check valves in either closed or open position.
B. Use the following precautions during storage:
   1. Maintain valve end protection.
   2. Store valves indoors and maintain at higher than ambient dew point temperature. If outdoor storage is necessary, store valves off the ground in watertight enclosures.
C. Use sling to handle large valves; rig sling to avoid damage to exposed parts. Do not use handwheels or stems as lifting or rigging points.

PART 2 PRODUCTS

2.01 GENERAL REQUIREMENTS FOR VALVES

A. Refer to valve schedule articles for applications of valves.
B. Valve Pressure and Temperature Ratings: Not less than indicated and as required for system pressures and temperatures.
C. Valve Sizes: Same as upstream piping unless otherwise indicated.
D. Valve Actuator Types:
   1. Handlever: For quarter-turn valves NPS 6 and smaller except plug valves.
   2. Wrench: For plug valves with square heads. Furnish Owner with 1 wrench for every 5 plug valves, for each size square plug-valve head.
E. Valves in Insulated Piping: With 2-inch stem extensions and the following features:
   1. Ball Valves: With extended operating handle of non-thermal-conductive material, and protective sleeve that allows operation of valve without breaking the vapor seal or disturbing insulation.
F. Valve-End Connections:
   1. Flanged: With flanges according to ASME B16.1 for iron valves.
   2. Grooved: With grooves according to AWWA C606.
   3. Solder Joint: With sockets according to ASME B16.18.
   4. Threaded: With threads according to ASME B1.20.1.
G. Valve Bypass and Drain Connections: MSS SP-45.

2.02 BRONZE BALL VALVES

A. Two-Piece, Full-Port, Bronze Ball Valves with Stainless-Steel Trim:
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      a. Conbraco Industries, Inc.; Apollo Valves.
      b. Crane Co.; Crane Valve Group; Crane Valves.
      c. Hammond Valve.

d. Milwaukee Valve Company.
e. NIBCO INC.
f. Watts Regulator Co.; a division of Watts Water Technologies, Inc.

2. Description:
a. Standard: MSS SP-110.
b. SWP Rating: 150 psig.
c. CWP Rating: 600 psig.
d. Body Design: Two piece.
e. Body Material: Bronze.
f. Ends: Threaded.
g. Seats: PTFE or TFE.
h. Stem: Stainless steel.
i. Ball: Stainless steel, vented.
j. Port: Full.

B. Three-Piece, Full-Port, Bronze Ball Valves with Stainless-Steel Trim:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
a. Conbraco Industries, Inc.; Apollo Valves.
b. Hammond Valve.
c. Milwaukee Valve Company.
d. NIBCO INC.

C. Description:
1. Standard: MSS SP-110.
2. SWP Rating: 150 psig.
3. CWP Rating: 600 psig.
4. Body Design: Three piece.
5. Body Material: Bronze.
6. Ends: Threaded.
7. Seats: PTFE or TFE.
8. Stem: Stainless steel.
9. Ball: Stainless steel, vented.
10. Port: Full.

2.03 BRONZE SWING CHECK VALVES

A. Class 125, Bronze Swing Check Valves with Bronze Disc:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
a. American Valve, Inc.
b. Crane Co.; Crane Valve Group; Crane Valves.
c. Crane Co.; Crane Valve Group; Jenkins Valves.
d. Crane Co.; Crane Valve Group; Stockham Division.
e. Hammond Valve.
f. Kitz Corporation.
g. Milwaukee Valve Company.

h. NIBCO INC.
i. Powell Valves.
j. Red-White Valve Corporation.
k. Watts Regulator Co.; a division of Watts Water Technologies, Inc.
l. Zy-Tech Global Industries, Inc.

2. Description:
a. Standard: MSS SP-80, Type 3.
b. CWP Rating: 200 psig.
c. Body Design: Horizontal flow.
d. Body Material: ASTM B 62, bronze.
e. Ends: Threaded.
f. Disc: Bronze.

B. Class 150, Bronze Swing Check Valves with Bronze Disc:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
a. American Valve, Inc.
b. Crane Co.; Crane Valve Group; Crane Valves.
c. Crane Co.; Crane Valve Group; Jenkins Valves.
d. Crane Co.; Crane Valve Group; Stockham Division.
e. Kitz Corporation.
f. Milwaukee Valve Company.
g. NIBCO INC.
h. Red-White Valve Corporation.
i. Zy-Tech Global Industries, Inc.

2. Description:
a. Standard: MSS SP-80, Type 3.
b. CWP Rating: 300 psig.
c. Body Design: Horizontal flow.
d. Body Material: ASTM B 62, bronze.
e. Ends: Threaded.
f. Disc: Bronze.

PART 3 EXECUTION

3.01 EXAMINATION

A. Examine valve interior for cleanliness, freedom from foreign matter, and corrosion. Remove special packing materials, such as blocks, used to prevent disc movement during shipping and handling.
B. Operate valves in positions from fully open to fully closed. Examine guides and seats made accessible by such operations.
C. Examine threads on valve and mating pipe for form and cleanliness.
D. Examine mating flange faces for conditions that might cause leakage. Check bolting for proper size, length, and material. Verify that gasket is of proper size, that its material composition is suitable for service, and that it is free from defects and damage.

E. Do not attempt to repair defective valves; replace with new valves.

3.02 VALVE INSTALLATION

A. Install valves with unions or flanges at each piece of equipment arranged to allow service, maintenance, and equipment removal without system shutdown.
B. Locate valves for easy access and provide separate support where necessary.
C. Install valves in horizontal piping with stem at or above center of pipe.
D. Install valves in position to allow full stem movement.
E. Install check valves for proper direction of flow and as follows:
   1. Swing Check Valves: In horizontal position with hinge pin level.
   2. Center-Guided and Plate-Type Check Valves: In horizontal or vertical position, between flanges.

3.03 ADJUSTING

A. Adjust or replace valve packing after piping systems have been tested and put into service but before final adjusting and balancing. Replace valves if persistent leaking occurs.

3.04 GENERAL REQUIREMENTS FOR VALVE APPLICATIONS

A. If valve applications are not indicated, use the following:
   1. Shutoff Service: Ball valves.
   2. Throttling Service, angle, ball valves.
   3. Pump-Discharge Check Valves:
      a. NPS 2 and Smaller: Bronze swing check valves with bronze disc.
      b. NPS 2-1/2 and Larger for Domestic Water: Iron swing check valves with spring.
      c. NPS 2-1/2 and Larger for Sanitary Waste and Storm Drainage: Iron swing check valves with spring.
B. If valves with specified SWP classes or CWP ratings are not available, the same types of valves with higher SWP classes or CWP ratings may be substituted.
C. Select valves, except wafer types, with the following end connections:
   1. For Copper Tubing, NPS 2 and Smaller: Threaded ends except where solder-joint valve-end option is indicated in valve schedules below.
   2. For Copper Tubing, NPS 2-1/2 to NPS 4: Flanged ends except where threaded valve-end option is indicated in valve schedules below.
   3. For Copper Tubing, NPS 5 and Larger: Flanged ends.
   4. For Steel Piping, NPS 2 and Smaller: Threaded ends.
   5. For Steel Piping, NPS 2-1/2 to NPS 4: Flanged ends except where threaded valve-end option is indicated in valve schedules below.
   6. For Steel Piping, NPS 5 and Larger: Flanged ends.

3.05 LOW-PRESSURE, COMPRESSED-AIR VALVE SCHEDULE (150 PSIG OR LESS)

A. Pipe NPS 2 and Smaller:
   1. Bronze Valves: May be provided with solder-joint ends instead of threaded ends.

2. Ball Valves: One, Two, or Three piece, full, regular or reduced port, with brass, bronze or stainless-steel trim.
3. Bronze Swing Check Valves: Class 125, bronze disc.

3.06 DOMESTIC, HOT- AND COLD-WATER VALVE SCHEDULE

A. Pipe NPS 2 and Smaller:
1. Bronze Valves: May be provided with solder-joint ends instead of threaded ends.
2. Bronze Angle Valves: Class 125 or Class 150, bronze disc.
3. Ball Valves: One, Two or Three piece, full, bronze with bronze or stainless-steel trim.
4. Bronze Swing Check Valves: Class 125 or Class 150, bronze disc.

END OF SECTION 22 0523

SECTION 22 0529 - HANGERS AND SUPPORTS FOR PLUMBING PIPING AND EQUIPMENT

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Furnish all labor, materials, equipment, tools and services required to fully complete all Hanger and Support work as is indicated on the drawings and/or specified herein including, but not limited to, the following described items.
   1. Steel pipe hangers and supports.
   2. Trapeze pipe hangers.
   3. Metal framing systems.
   4. Thermal-hanger shield inserts.
   5. Fastener systems.
   6. Pipe stands.
   7. Pipe positioning systems.
   8. Equipment supports.

1.02 RELATED REQUIREMENTS

A. Division 05 Section "Metal Fabrications" for structural-steel shapes and plates for trapeze hangers for pipe and equipment supports.
B. Division 21 Section "Water-Based Fire-Suppression Systems" for pipe hangers for fire-suppression piping.
C. Division 22 Section "Expansion Fittings and Loops for Plumbing Piping" for pipe guides and anchors.
D. Division 22 Section "Vibration and Seismic Controls for Plumbing Piping and Equipment" for vibration isolation devices.

1.03 DEFINITIONS

A. MSS: Manufacturers Standardization Society for The Valve and Fittings Industry Inc.
B. Terminology: As defined in MSS SP-90, "Guidelines on Terminology for Pipe Hangers and Supports."

1.04 PERFORMANCE REQUIREMENTS

A. Design supports for multiple pipes, including pipe stands, capable of supporting combined weight of supported systems, system contents, and test water.
B. Design equipment supports capable of supporting combined operating weight of supported equipment and connected systems and components.
C. Seismic Performance: Plumbing equipment, hangers and supports shall withstand the effects of earthquake motions determined according to SEI/ASCE 7 and with the requirements specified in Section 22 0548 “Vibration and Seismic Controls for Plumbing Piping and Equipment.

1. For components with a seismic importance factor of 1.0 the term "withstand" means "the system will remain in place without separation of any parts when subjected to the seismic forces specified."
2. For components with a seismic importance factor of 1.5 the term "withstand" means "the system will remain in place without separation of any parts when subjected to the seismic forces specified and the system will be fully operational after the seismic event."

1.05 SUBMITTALS

A. Product Data: For the following:
   1. Steel pipe hangers and supports.
   2. Thermal-hanger shield inserts.
   3. Powder-actuated fastener systems.
   4. Pipe positioning systems.
   5. Mechanical Anchors: ICC-ES Evaluation Reports validating ‘Cracked Concrete’ testing per A.C. 193 must be provided for anchors resisting seismic loads and/or supporting life- safety systems including fire sprinkler systems.
B. Shop Drawings: Signed and sealed by a qualified professional engineer. Show fabrication and installation details and include calculations for the following:
   1. Trapeze pipe hangers. Include Product Data for components.
   2. Metal framing systems. Include Product Data for components.
   3. Pipe stands. Include Product Data for components.
   4. Equipment supports.
C. Welding certificates.
D. Delegated-Design Submittal:
   1. Design calculations and detailed fabrication and assembly of pipe anchors and alignment guides, hangers and supports for multiple pipes, expansion joints and loops, and attachments of the same to the building structure.
   2. Locations of pipe anchors and alignment guides and expansion joints and loops.
   3. Locations of and details for penetrations, including sleeves and sleeve seals for exterior walls, floors, basement, and foundation walls.
   4. Seismic calculations and detailed analysis: Indicate fabrication and arrangement. Detail attachments of restraints to the restrained items and to the structure. Show attachment locations, methods, and spacings. Identify components, list their strengths, and indicate directions and values of forces transmitted to the structure during seismic events. Indicate association with vibration isolation devices. Project specific design documentation and calculations shall be prepared and stamped by a registered professional engineer who is responsible for the seismic restraint design and who is licensed in the state where the project is being constructed (ASCE 7, 13.2.1.1).

1.06 QUALITY ASSURANCE

A. Welding: Qualify procedures and personnel according to AWS D1.1, "Structural Welding Code--Steel.", AWS D1.4, "Structural Welding Code--Reinforcing Steel." and ASME Boiler and Pressure Vessel Code: Section IX.
B. Welding: Qualify procedures and personnel according to the following:
   1. AWS D1.1, "Structural Welding Code--Steel."
   2. AWS D1.2, "Structural Welding Code--Aluminum."
   3. AWS D1.4, "Structural Welding Code--Reinforcing Steel."
   4. ASME Boiler and Pressure Vessel Code: Section IX.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. In other Part 2 articles where titles below introduce lists, the following requirements apply to product selection:
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the manufacturers specified.

2.02 STEEL PIPE HANGERS AND SUPPORTS

A. Description: MSS SP-58, Types 1 through 58, factory-fabricated components. Refer to Part 3 "Hanger and Support Applications" Article for where to use specific hanger and support types.
B. Manufacturers:
   1. Anvil International.
   2. AAA Technology & Specialties Co., Inc.
   3. Bergen-Power Pipe Supports.
   4. B-Line Systems, Inc.; a division of Cooper Industries.
   5. Carpenter & Paterson, Inc.
   6. Empire Industries, Inc.
   7. ERICO/Michigan Hanger Co.
   8. Globe Pipe Hanger Products, Inc.
   9. Grinnell Corp.
   10. GS Metals Corp.
   11. National Pipe Hanger Corporation.
   12. PHD Manufacturing, Inc.
   13. PHS Industries, Inc.
   14. Piping Technology & Products, Inc.
   15. Tolco Inc.
   16. Simpson Strong-Tie Co.
C. Galvanized, Metallic Coatings: Pregalvanized or hot dipped.
D. Nonmetallic Coatings: Plastic coating, jacket, or liner.

E. Padded Hangers: Hanger with fiberglass or other pipe insulation pad or cushion for support of bearing surface of piping.

2.03 TRAPEZE PIPE HANGERS

A. Description: MSS SP-69, Type 59, shop- or field-fabricated pipe-support assembly made from structural-steel shapes with MSS SP-58 hanger rods, nuts, saddles, and U-bolts.

2.04 METAL FRAMING SYSTEMS

A. Description: MFMA-3, shop- or field-fabricated pipe-support assembly made of steel channels and other components.
B. Manufacturers:
   1. Anvil International.
   2. B-Line Systems, Inc.; a division of Cooper Industries.
   3. ERICO/Michigan Hanger Co.; ERISTRUT Div.
   4. GS Metals Corp.
   5. Hilti, Inc.
   6. Power-Strut Div.; Tyco International, Ltd.
   7. Thomas & Betts Corporation.
   8. Tolco Inc.
   9. Unistrut Corp.; Tyco International, Ltd.
C. Coatings: Manufacturer's standard finish unless bare metal surfaces are indicated.
D. Nonmetallic Coatings: Plastic coating, jacket, or liner.

2.05 THERMAL-HANGER SHIELD INSERTS

A. Description: 100-psig- minimum, compressive-strength insulation insert encased in sheet metal shield.
B. Manufacturers:
   1. Carpenter & Paterson, Inc.
   2. ERICO/Michigan Hanger Co.
   3. PHS Industries, Inc.
   4. Pipe Shields, Inc.
   5. Rilco Manufacturing Company, Inc.
   6. Value Engineered Products, Inc.
C. Insulation-Insert Material for Cold Piping: Water-repellent treated, ASTM C 533, Type I calcium silicate with vapor barrier.
D. Insulation-Insert Material for Hot Piping: Water-repellent treated, ASTM C 533, Type I calcium silicate.
E. For Trapeze or Clamped Systems: Insert and shield shall cover entire circumference of pipe.
F. For Clevis or Band Hangers: Insert and shield shall cover lower 180 degrees of pipe.
G. Insert Length: Extend 2 inches beyond sheet metal shield for piping operating below ambient air temperature.

2.06 FASTENER SYSTEMS

A. Powder-Actuated Fasteners: Threaded-steel stud, for use in hardened portland cement concrete with pull-out, tension, and shear capacities appropriate for supported loads and building materials where used.
   1. Manufacturers:
      a. Hilti, Inc.
      b. MKT Fastening, LLC.
      c. Powers Fasteners.
      d. Simpson Strong-Tie Co.

B. Mechanical-Expansion Anchors and Concrete Screws: Insert-wedge-type stainless steel, for use in hardened portland cement concrete with pull-out, tension, and shear capacities appropriate for supported loads and building materials where used. For anchors resisting seismic loads and/or supporting life- safety systems including fire sprinkler systems, Anchors shall have been tested for 'Cracked Concrete' per A.C. 193 per a valid ICC-ES Evaluation Report. Manufacturers with these anchors have been designated below with: '*'
   1. Manufacturers:
      a. B-Line Systems, Inc.; a division of Cooper Industries.
      b. Empire Industries, Inc.
      c. Hilti, Inc.
      d. ITW Ramset/Red Head.
      e. MKT Fastening, LLC.
      f. Powers Fasteners.
      g. Simpson Strong-Tie Co. *

2.07 PIPE STAND FABRICATION

A. Pipe Stands, General: Shop or field-fabricated assemblies made of manufactured corrosion-resistant components to support roof-mounted piping.

B. Compact Pipe Stand: One-piece plastic unit with integral-rod-roller, pipe clamps, or V-shaped cradle to support pipe, for roof installation without membrane penetration.
   1. Manufacturers:
      a. Anvil International.
      b. ERICO/Michigan Hanger Co.
      c. MIRO Industries.
      d. Unipure

C. Low-Type, Single-Pipe Stand: One-piece stainless-steel base unit with plastic roller, for roof installation without membrane penetration.
   1. Manufacturers:
      a. MIRO Industries.

D. High-Type, Single-Pipe Stand: Assembly of base, vertical and horizontal members, and pipe support, for roof installation without membrane penetration.
   1. Manufacturers:

a. Anvil International.
b. ERICO/Michigan Hanger Co.
c. MIRO Industries.
d. Portable Pipe Hangers.

2. Base: Stainless steel.
3. Vertical Members: Two or more cadmium-plated-steel or stainless-steel, continuous-thread rods.
4. Horizontal Member: Cadmium-plated-steel or stainless-steel rod with plastic or stainless-steel, roller-type pipe support.

E. High-Type, Multiple-Pipe Stand: Assembly of bases, vertical and horizontal members, and pipe supports, for roof installation without membrane penetration.
1. Manufacturers:
a. Anvil International.
b. Portable Pipe Hangers.
2. Bases: One or more plastic.
3. Vertical Members: Two or more protective-coated-steel channels.
4. Horizontal Member: Protective-coated-steel channel.
5. Pipe Supports: Galvanized-steel, clevis-type pipe hangers.

F. Curb-Mounting-Type Pipe Stands: Shop- or field-fabricated pipe support made from structural-steel shape, continuous-thread rods, and rollers for mounting on permanent stationary roof curb.

2.08 PIPE POSITIONING SYSTEMS

A. Description: IAPMO PS 42, system of metal brackets, clips, and straps for positioning piping in pipe spaces for plumbing fixtures for commercial applications.
B. Manufacturers:
1. C & S Mfg. Corp.
2. HOLDRITE Corp.; Hubbard Enterprises.
3. Samco Stamping, Inc.

2.09 EQUIPMENT SUPPORTS

A. Description: Welded, shop- or field-fabricated equipment support made from structural-steel shapes.

2.10 MISCELLANEOUS MATERIALS

A. Structural Steel: ASTM A 36/A 36M, steel plates, shapes, and bars; black and galvanized.
B. Grout: ASTM C 1107, factory-mixed and -packaged, dry, hydraulic-cement, nonshrink and nonmetallic grout; suitable for interior and exterior applications.
1. Properties: Nonstaining, noncorrosive, and nongaseous.
2. Design Mix: 5000-psi, 28-day compressive strength.

PART 3 EXECUTION

3.01 HANGER AND SUPPORT APPLICATIONS

A. Specific hanger and support requirements are specified in Sections specifying piping systems and equipment.
B. Comply with MSS SP-69 for pipe hanger selections and applications that are not specified in piping system Sections.
C. Use hangers and supports with galvanized, metallic coatings for piping and equipment that will not have field-applied finish.
D. Use nonmetallic coatings on attachments for electrolytic protection where attachments are in direct contact with copper tubing.
E. Use padded hangers for piping that is subject to scratching.
F. Horizontal-Piping Hangers and Supports: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
    1. Adjustable, Steel Clevis Hangers (MSS Type 1): For suspension of noninsulated or insulated stationary pipes, NPS 1/2 to NPS 30.
    2. Yoke-Type Pipe Clamps (MSS Type 2): For suspension of 120 to 450 deg F pipes, NPS 4 to NPS 16, requiring up to 4 inches of insulation.
    3. Carbon- or Alloy-Steel, Double-Bolt Pipe Clamps (MSS Type 3): For suspension of pipes, NPS 3/4 to NPS 24, requiring clamp flexibility and up to 4 inches of insulation.
    4. Steel Pipe Clamps (MSS Type 4): For suspension of cold and hot pipes, NPS 1/2 to NPS 24, if little or no insulation is required.
    5. Pipe Hangers (MSS Type 5): For suspension of pipes, NPS 1/2 to NPS 4, to allow off-center closure for hanger installation before pipe erection.
    6. Adjustable, Swivel Split- or Solid-Ring Hangers (MSS Type 6): For suspension of noninsulated stationary pipes, NPS 3/4 to NPS 8.
    7. Adjustable, Steel Band Hangers (MSS Type 7): For suspension of noninsulated stationary pipes, NPS 1/2 to NPS 8.
    8. Adjustable Band Hangers (MSS Type 9): For suspension of noninsulated stationary pipes, NPS 1/2 to NPS 8.
    9. Adjustable, Swivel-Ring Band Hangers (MSS Type 10): For suspension of noninsulated stationary pipes, NPS 1/2 to NPS 2.
    10. Split Pipe-Ring with or without Turnbuckle-Adjustment Hangers (MSS Type 11): For suspension of noninsulated stationary pipes, NPS 3/8 to NPS 8.
    11. Extension Hinged or 2-Bolt Split Pipe Clamps (MSS Type 12): For suspension of noninsulated stationary pipes, NPS 3/8 to NPS 3.
    12. U-Bolts (MSS Type 24): For support of heavy pipes, NPS 1/2 to NPS 30.
    13. Clips (MSS Type 26): For support of insulated pipes not subject to expansion or contraction.
    14. Pipe Saddle Supports (MSS Type 36): For support of pipes, NPS 4 to NPS 36, with steel pipe base stanchion support and cast-iron floor flange.

15. Pipe Stanchion Saddles (MSS Type 37): For support of pipes, NPS 4 to NPS 36, with steel pipe base stanchion support and cast-iron floor flange and with U-bolt to retain pipe.
16. Adjustable, Pipe Saddle Supports (MSS Type 38): For stanchion-type support for pipes, NPS 2-1/2 to NPS 36, if vertical adjustment is required, with steel pipe base stanchion support and cast-iron floor flange.
17. Single Pipe Rolls (MSS Type 41): For suspension of pipes, NPS 1 to NPS 30, from 2 rods if longitudinal movement caused by expansion and contraction might occur.
18. Adjustable Roller Hangers (MSS Type 43): For suspension of pipes, NPS 2-1/2 to NPS 20, from single rod if horizontal movement caused by expansion and contraction might occur.
19. Complete Pipe Rolls (MSS Type 44): For support of pipes, NPS 2 to NPS 42, if longitudinal movement caused by expansion and contraction might occur but vertical adjustment is not necessary.
20. Pipe Roll and Plate Units (MSS Type 45): For support of pipes, NPS 2 to NPS 24, if small horizontal movement caused by expansion and contraction might occur and vertical adjustment is not necessary.
21. Adjustable Pipe Roll and Base Units (MSS Type 46): For support of pipes, NPS 2 to NPS 30, if vertical and lateral adjustment during installation might be required in addition to expansion and contraction.

G. Vertical-Piping Clamps: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
1. Extension Pipe or Riser Clamps (MSS Type 8): For support of pipe risers, NPS 3/4 to NPS 20.
2. Carbon- or Alloy-Steel Riser Clamps (MSS Type 42): For support of pipe risers, NPS 3/4 to NPS 20, if longer ends are required for riser clamps.

H. Hanger-Rod Attachments: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
1. Steel Turnbuckles (MSS Type 13): For adjustment up to 6 inches for heavy loads.
2. Steel Clevises (MSS Type 14): For 120 to 450 deg F piping installations.
3. Swivel Turnbuckles (MSS Type 15): For use with MSS Type 11, split pipe rings.
4. Malleable-Iron Sockets (MSS Type 16): For attaching hanger rods to various types of building attachments.
5. Steel Weldless Eye Nuts (MSS Type 17): For 120 to 450 deg F piping installations.

I. Building Attachments: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
1. Steel or Malleable Concrete Inserts (MSS Type 18 or Simpson Blue Banger Concrete insert with UL & FM approvals): For upper attachment to suspend pipe hangers from concrete ceiling.
2. Top-Beam C-Clamps (MSS Type 19): For use under roof installations with bar-joist construction to attach to top flange of structural shape.
3. Side-Beam or Channel Clamps (MSS Type 20): For attaching to bottom flange of beams, channels, or angles.

4. Center-Beam Clamps (MSS Type 21): For attaching to center of bottom flange of beams.
5. Welded Beam Attachments (MSS Type 22): For attaching to bottom of beams if loads are considerable and rod sizes are large.
6. C-Clamps (MSS Type 23): For structural shapes.
7. Top-Beam Clamps (MSS Type 25): For top of beams if hanger rod is required tangent to flange edge.
8. Side-Beam Clamps (MSS Type 27): For bottom of steel I-beams.
9. Steel-Beam Clamps with Eye Nuts (MSS Type 28): For attaching to bottom of steel I-beams for heavy loads.
10. Linked-Steel Clamps with Eye Nuts (MSS Type 29): For attaching to bottom of steel I-beams for heavy loads, with link extensions.
11. Malleable Beam Clamps with Extension Pieces (MSS Type 30): For attaching to structural steel.
12. Welded-Steel Brackets: For support of pipes from below, or for suspending from above by using clip and rod. Use one of the following for indicated loads:
    a. Light (MSS Type 31): 750 lb.
    b. Medium (MSS Type 32): 1500 lb.
    c. Heavy (MSS Type 33): 3000 lb.
13. Side-Beam Brackets (MSS Type 34): For sides of steel or wooden beams.
14. Plate Lugs (MSS Type 57): For attaching to steel beams if flexibility at beam is required.
15. Horizontal Travelers (MSS Type 58): For supporting piping systems subject to linear horizontal movement where headroom is limited.

J. Saddles and Shields: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
1. Steel Pipe-Covering Protection Saddles (MSS Type 39): To fill interior voids with insulation that matches adjoining insulation.
2. Protection Shields (MSS Type 40): Of length recommended in writing by manufacturer to prevent crushing insulation.
3. Thermal-Hanger Shield Inserts: For supporting insulated pipe.

K. Spring Hangers and Supports: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
1. Restraint-Control Devices (MSS Type 47): Where indicated to control piping movement.
2. Spring Cushions (MSS Type 48): For light loads if vertical movement does not exceed 1-1/4 inches.
3. Spring-Cushion Roll Hangers (MSS Type 49): For equipping Type 41 roll hanger with springs.
4. Spring Sway Braces (MSS Type 50): To retard sway, shock, vibration, or thermal expansion in piping systems.
5. Variable-Spring Hangers (MSS Type 51): Preset to indicated load and limit variability factor to 25 percent to absorb expansion and contraction of piping system from hanger.

6. Variable-Spring Base Supports (MSS Type 52): Preset to indicated load and limit variability factor to 25 percent to absorb expansion and contraction of piping system from base support.
7. Variable-Spring Trapeze Hangers (MSS Type 53): Preset to indicated load and limit variability factor to 25 percent to absorb expansion and contraction of piping system from trapeze support.
8. Constant Supports: For critical piping stress and if necessary to avoid transfer of stress from one support to another support, critical terminal, or connected equipment. Include auxiliary stops for erection, hydrostatic test, and load-adjustment capability. These supports include the following types:
   a. Horizontal (MSS Type 54): Mounted horizontally.
   b. Vertical (MSS Type 55): Mounted vertically.
   c. Trapeze (MSS Type 56): Two vertical-type supports and one trapeze member.

L. Comply with MSS SP-69 for trapeze pipe hanger selections and applications that are not specified in piping system Sections.
M. Comply with MFMA-102 for metal framing system selections and applications that are not specified in piping system Sections.
N. Use powder-actuated fasteners or mechanical-expansion anchors instead of building attachments where required in concrete construction.
O. Use pipe positioning systems in pipe spaces behind plumbing fixtures to support supply and waste piping for plumbing fixtures.

3.02 HANGER AND SUPPORT INSTALLATION

A. Comply with SEI/ASCE 7 and with requirements for seismic-restraint devices in Section 220548 "Vibration and Seismic Controls for Plumbing Piping and Equipment."
B. Steel Pipe Hanger Installation: Comply with MSS SP-69 and MSS SP-89. Install hangers, supports, clamps, and attachments as required to properly support piping from building structure.
C. Trapeze Pipe Hanger Installation: Comply with MSS SP-69 and MSS SP-89. Arrange for grouping of parallel runs of horizontal piping and support together on field-fabricated trapeze pipe hangers.
   1. Pipes of Various Sizes: Support together and space trapezes for smallest pipe size or install intermediate supports for smaller diameter pipes as specified above for individual pipe hangers.
   2. Field fabricate from ASTM A 36/A 36M, steel shapes selected for loads being supported. Weld steel according to AWS D1.1.
D. Metal Framing System Installation: Arrange for grouping of parallel runs of piping and support together on field-assembled metal framing systems.
E. Thermal-Hanger Shield Installation: Install in pipe hanger or shield for insulated piping.
F. Fastener System Installation:

1. Install powder-actuated fasteners for use in lightweight concrete or concrete slabs less than 4 inches thick in concrete after concrete is placed and completely cured. Use operators that are licensed by powder-actuated tool manufacturer. Install fasteners according to powder-actuated tool manufacturer's operating manual. Powder actuated fasteners shall not be used for seismic bracing attachments.
2. Install mechanical-expansion anchors in concrete after concrete is placed and completely cured. Install fasteners according to manufacturer's written instructions. For anchors resisting seismic loads and/or supporting life-safety systems including fire sprinkler systems, anchors shall have been tested for 'Cracked Concrete' per A.C. 193 and shall have a valid ICC-ES Evaluation Report

G. Pipe Stand Installation:
1. Pipe Stand Types except Curb-Mounting Type: Assemble components and mount on smooth roof surface. Do not penetrate roof membrane.
2. Curb-Mounting-Type Pipe Stands: Assemble components or fabricate pipe stand and mount on permanent, stationary roof curb. Refer to Division 07 Section "Roof Accessories" for curbs.

H. Pipe Positioning System Installation: Install support devices to make rigid supply and waste piping connections to each plumbing fixture. Refer to Division 22 Section "Plumbing Fixtures" for plumbing fixtures.

I. Install hangers and supports complete with necessary inserts, bolts, rods, nuts, washers, and other accessories.

J. Equipment Support Installation: Fabricate from welded-structural-steel shapes.

K. Install hangers and supports to allow controlled thermal and seismic movement of piping systems, to permit freedom of movement between pipe anchors, and to facilitate action of expansion joints, expansion loops, expansion bends, and similar units.

L. Install lateral bracing with pipe hangers and supports to prevent swaying.

M. Install building attachments within concrete slabs or attach to structural steel. Install additional attachments at concentrated loads, including valves, flanges, and strainers, NPS 2-1/2 and larger and at changes in direction of piping. Install concrete inserts before concrete is placed; fasten inserts to forms and install reinforcing bars through openings at top of inserts.

N. Load Distribution: Install hangers and supports so piping live and dead loads and stresses from movement will not be transmitted to connected equipment.

O. Pipe Slopes: Install hangers and supports to provide indicated pipe slopes and so maximum pipe deflections allowed by ASME B31.9 (for building services piping) are not exceeded.

P. Insulated Piping: Comply with the following:
1. Attach clamps and spacers to piping.
   a. Piping Operating above Ambient Air Temperature: Clamp may project through insulation.
   b. Piping Operating below Ambient Air Temperature: Use thermal-hanger shield insert with clamp sized to match OD of insert.
   c. Do not exceed pipe stress limits according to ASME B31.9 for building services piping.

2. Install MSS SP-58, Type 39, protection saddles if insulation without vapor barrier is indicated. Fill interior voids with insulation that matches adjoining insulation.
   a. Option: Thermal-hanger shield inserts may be used. Include steel weight-distribution plate for pipe NPS 4 and larger if pipe is installed on rollers.
3. Install MSS SP-58, Type 40, protective shields on cold piping with vapor barrier. Shields shall span an arc of 180 degrees.
   a. Option: Thermal-hanger shield inserts may be used. Include steel weight-distribution plate for pipe NPS 4 and larger if pipe is installed on rollers.
4. Shield Dimensions for Pipe: Not less than the following:
   a. NPS 1/4 to NPS 3-1/2: 12 inches long and 0.048 inch thick.
   b. NPS 4: 12 inches long and 0.06 inch thick.
   c. NPS 5 and NPS 6: 18 inches long and 0.06 inch thick.
   d. NPS 8 to NPS 14: 24 inches long and 0.075 inch thick.
   e. NPS 16 to NPS 24: 24 inches long and 0.105 inch thick.
5. Pipes NPS 8 and Larger: Include wood inserts.
6. Insert Material: Length at least as long as protective shield.
7. Thermal-Hanger Shields: Install with insulation same thickness as piping insulation.

3.03 EQUIPMENT SUPPORTS

A. Fabricate structural-steel stands to suspend equipment from structure overhead or to support equipment above floor.
B. Grouting: Place grout under supports for equipment and make smooth bearing surface.
C. Provide lateral bracing, to prevent swaying, for equipment supports. For applications where seismic bracing is required, 'Cracked Concrete' expansion anchors or concrete screws tested per A.C. 193 must be provided for seismic bracing anchorage where post-installed anchors are required.

3.04 METAL FABRICATIONS

A. Cut, drill, and fit miscellaneous metal fabrications for trapeze pipe hangers and equipment supports.
B. Fit exposed connections together to form hairline joints. Field weld connections that cannot be shop welded because of shipping size limitations.
C. Field Welding: Comply with AWS D1.1 procedures for shielded metal arc welding, appearance and quality of welds, and methods used in correcting welding work, and with the following:
   1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
   2. Obtain fusion without undercut or overlap.
   3. Remove welding flux immediately.
   4. Finish welds at exposed connections so no roughness shows after finishing and contours of welded surfaces match adjacent contours.

3.05 ADJUSTING

A. Hanger Adjustments: Adjust hangers to distribute loads equally on attachments and to achieve indicated slope of pipe.
B. Trim excess length of continuous-thread hanger and support rods to 1-1/2 inches .

3.06 PAINTING

A. Touch Up: Clean field welds and abraded areas of shop paint. Paint exposed areas immediately after erecting hangers and supports. Use same materials as used for shop painting. Comply with SSPC-PA 1 requirements for touching up field-painted surfaces.
   1. Apply paint by brush or spray to provide minimum dry film thickness of 2.0 mils.
B. Touch Up: Cleaning and touchup painting of field welds, bolted connections, and abraded areas of shop paint on miscellaneous metal are specified in Division 09 painting Sections.
C. Galvanized Surfaces: Clean welds, bolted connections, and abraded areas and apply galvanizing-repair paint to comply with ASTM A 780.

END OF SECTION 22 0529

SECTION 22 0548 - VIBRATION AND SEISMIC CONTROLS FOR PLUMBING PIPING AND EQUIPMENT

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Furnish all labor, materials, equipment, tools and services required to fully complete all Plumbing Vibration Isolation and Seismic Control. Work as is indicated on the drawings and/or specified herein including, but not limited to, the following described items.

B. The following restraints and vibration isolation as defined in Section 23 0548 “Vibration Isolation and Seismic Controls for HVAC” for the following:
   1. Plumbing Piping.
   2. Plumbing Equipment.

PART 2 PRODUCTS

(NOT USED)

PART 3 EXECUTION

(NOT USED)

END OF SECTION 22 0548

SECTION 220553 - IDENTIFICATION FOR PLUMBING PIPING AND EQUIPMENT

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Equipment labels.
2. Warning signs and labels.
3. Pipe labels.
4. Stencils.
5. Valve tags.
6. Warning tags.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product indicated.

B. Samples: For color, letter style, and graphic representation required for each identification material and device.

C. Equipment Label Schedule: Include a listing of all equipment to be labeled with the proposed content for each label.

D. Valve numbering scheme.

E. Valve Schedules: For each piping system to be included in maintenance manuals.

PART 2 - PRODUCTS

2.1 EQUIPMENT LABELS

A. Plastic Labels for Equipment:
1. Approved Manufacturers:
    a. Emedco
    b. Graphic Products, Inc.
    c. Brady Corporation

d. Seton Nameplate Corp.

2. Material and Thickness: Multilayer, multicolor, plastic labels for mechanical engraving, 1/16 inch (1.6 mm) thick, and having predrilled holes for attachment hardware.
3. Letter Color: White.
4. Background Color: Black.
5. Maximum Temperature: Able to withstand temperatures up to 160 deg F (71 deg C).
6. Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2 by 3/4 inch (64 by 19 mm).
7. Minimum Letter Size: 1/4 inch (6.4 mm) for name of units if viewing distance is less than 24 inches (600 mm), 1/2 inch (13 mm) for viewing distances up to 72 inches (1830 mm), and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-quarters the size of principal lettering.
8. Fasteners: Stainless-steel rivets or self-tapping screws.
9. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.

B. Label Content: Include equipment's Drawing designation or unique equipment number, Drawing numbers where equipment is indicated (plans, details, and schedules), and the Specification Section number and title where equipment is specified.

C. Equipment Label Schedule: For each item of equipment to be labeled, on 8-1/2-by-11-inch (A4) bond paper. Tabulate equipment identification number, and identify Drawing numbers where equipment is indicated (plans, details, and schedules) and the Specification Section number and title where equipment is specified. Equipment schedule shall be included in operation and maintenance data.

2.2 PIPE LABELS

A. Pipe Labels

1. Printed plastic with contact-type, permanent-adhesive backing.
2. Size and Colors in accordance with the requirements of this specification.
3. Pipe Label Contents: Include identification of piping service using same designations or abbreviations as scheduled and an arrow indicating flow direction.
4. Flow-Direction Arrows: Integral with piping system service lettering to accommodate both directions, or as separate unit on each pipe label to indicate flow direction.
5. Label thickness shall be a minimum of 2 mils.
6. Labels shall have 100% adhesive coating.
7. Label font shall be Arial Black in all capital letters.
8. Labels and color banding shall withstand temperatures up to 160°F.
9. Direction of flow arrows shall be included on all labels at the same size as the label text and placed on the downflow side of the label text.
10. Color banding shall be 1.5” or 2” wide and minimum 2 mils. thick and placed on the up-flow side of the label text.
11. For piping with PVC insulation jacketing, apply label and color banding directly to PVC

jacketing.

12. For insulated pipes not covered with PVC jacketing, wrap a section of pipe with white PVC jacketing and apply label and color banding to PVC jacketing.
13. For non-insulated piping, wrap section of pipe with white PVC jacketing and apply label and color banding to PVC jacketing.
14. All steam and condensate lines to include pressure range on the label.

B. Lettering Size:

OUTSIDE DIAMETER OF PIPE OR COVERING	SIZE OF LETTERS
¾" to 1-1/4"	½"
1-1/2" to 2"	¾"
2-1/2" to 6"	1 ¼"
8" to 10"	2 ½"
Over 10"	3 ½"

C. Label Background Color and Lettering Color shall be as follows:

LABEL BACKGROUND COLOR	FONT COLOR
Yellow	Black
Brown	Black
Orange	Black
Red	White
Green	White
Blue	White
White	Black
Black	White
Purple	White
Gray	White

D. Manufacturers:

a. Seton
b. Emedco
c. Graphic Products, Inc.
d. Brady Corporation
e. Engineer approved equal.

2.3 VALVE TAGS

A. Valve Tags: Stamped or engraved with 1/4-inch (6.4-mm) letters for piping system abbreviation and 1/2-inch (13-mm) numbers.

1. Tag Material: Brass, 0.032-inch (0.8-mm) or aluminum, 0.032-inch (0.8-mm) minimum thickness, and having predrilled or stamped holes for attachment hardware.
2. Fasteners: Brass wire-link chain or beaded chain.

B. Valve Schedules: For each piping system, on 8-1/2-by-11-inch (A4) bond paper. Tabulate valve number, piping system, system abbreviation (as shown on valve tag), location of valve (room or space), normal-operating position (open, closed, or modulating), and variations for identification. Mark valves for emergency shutoff and similar special uses.

1. Valve-tag schedule shall be included in operation and maintenance data.

PART 3 - EXECUTION

3.1 PREPARATION

A. Clean piping and equipment surfaces of substances that could impair bond of identification devices, including dirt, oil, grease, release agents, and incompatible primers, paints, and encapsulants.

3.2 GENERAL INSTALLATION REQUIREMENTS

A. Coordinate installation of identifying devices with completion of covering and painting of surfaces where devices are to be applied.

B. Coordinate installation of identifying devices with locations of access panels and doors.

C. Install identifying devices before installing acoustical ceilings and similar concealment.

3.3 EQUIPMENT LABEL INSTALLATION

A. Install or permanently fasten labels on each major item of mechanical equipment.

B. Locate equipment labels where accessible and visible.

3.4 PIPE LABEL INSTALLATION

A. Install pipe labels with color-coded bands and flow direction arrows on each piping system.

B. Locate pipe labels where piping is exposed or above accessible ceilings in finished spaces; in mechanical rooms, in accessible maintenance spaces such as shafts, tunnels, and plenums; and exterior exposed locations.

C. For new insulated piping with cleanable facing to which labels will adhere, clean facing, and apply label and color banding to facing.

D. For existing insulated piping, not covered with PVC jacketing, that are worn and dirty, to which labels will not adhere, wrap a section of pipe with white PVC jacketing and apply label and color banding to PVC jacketing.

E. For piping with PVC insulation jacketing, apply label and color banding directly to PVC jacketing.

F. For non-insulated piping or insulation without a facing, wrap a section of pipe with white PVC jacketing and apply label and color banding to PVC jacketing.

G. Locate pipe labels as follows:

1. Near each valve and control device.
2. Near each branch connection, excluding short takeoffs for fixtures and terminal units. Where flow pattern is not obvious, mark each pipe at branch.
3. Near changes in pipe direction.
4. Near penetrations through walls, floors, ceilings, and inaccessible enclosures. Provide labels on both sides of the penetration.
5. At access doors, manholes, and similar access points that permit view of concealed piping.
6. Adjacent to each item of equipment and other points of origination and termination.
7. Spaced at maximum intervals of 40 feet along each run. Reduce intervals to 25 feet in areas of congested piping and equipment.
8. On each riser and junction.
9. Locate so labels are visible from point of normal approach. Label larger pipes on both sides if visible.

3.5 VALVE-TAG INSTALLATION

A. Install tags on valves and control devices in piping systems, except check valves, valves within factory-fabricated equipment units, shutoff valves, faucets, convenience and lawn-watering hose connections, and similar roughing-in connections of end-use fixtures and units. List tagged valves in a valve schedule.

B. Valve-Tag Application Schedule: Tag valves according to size, shape, and color scheme and with captions similar to those indicated in the following subparagraphs:

1. Valve-Tag Size and Shape:

a. Cold Water: 1-1/2 inches (38 mm).
b. Hot Water: 1-1/2 inches (38 mm).
c. Low-Pressure Compressed Air: 1-1/2 inches (38 mm).

2. Valve-Tag Colors:

a. Cold Water: Natural.
b. Hot Water: Natural.
c. Low-Pressure Compressed Air: natural.

3. Letter Colors:

a. Cold Water: White.
b. Hot Water: White.
c. Low-Pressure Compressed Air: White.

3.6 WARNING-TAG INSTALLATION

A. Write required message on, and attach warning tags to, equipment and other items where required.

3.7 SCHEDULES

A. Piping identification shall be in accordance with the following table for listed service, identification label wording, and color.

PIPE SERVICE	IDENTIFICATION OR SYMBOL / WORDING (FONT: ARIAL BLACK)	BANDING COLOR(S)	LABEL BACKGROUND COLOR
Domestic Cold Water	D CLD W	Light Blue	Green
Domestic Soft Cold Water	D SOFT CLD W	Light Blue	Green
Domestic Hot Water (110˚ F.)	D HT W S 110	Light Blue	Green
Domestic Hot Water Return (110˚ F.)	D HT W R 110	Light Blue	Green

Domestic Hot Water (140˚ F.)	D HT W S 140	Light Blue	Green
Domestic Hot Water Return (140˚ F.)	D HT W R 140	Light Blue	Green
Roof Drain	ROOF D	Black	White
Overflow Roof Drain	ROOF OD	Black	White
Sanitary Sewer	SS	Black	White
Wastewater	WW	Black	White
Storm Drain	STRM D	Black	White
Vent	VENT	Black	White
Compressed Air	COMP AIR	Orange & Gray	Blue
Makeup Water	W MU	Green	Green
Fire Sprinkler	Fire	Red	Red

END OF SECTION 220553

SECTION 22 0719 - PLUMBING PIPING INSULATION

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Furnish all labor, materials, equipment, tools and services required to fully complete all Plumbing Pipe Insulation work as is indicated on the drawings and/or specified herein including, but not limited to, the following described items.
   1. Insulating the following plumbing piping services:
      a. Domestic cold-water piping.
      b. Domestic hot-water piping.
      c. Domestic recirculating hot-water piping.
      d. Roof drains and rainwater leaders.
      e. Supplies and drains for handicap-accessible lavatories and sinks.

1.02 DEFINITIONS:

A. Refer to Section 22 0500 “Common Work Results for Plumbing”.

1.03 ACTION SUBMITTALS

A. Product Data: For each type of product indicated. Include thermal conductivity, water-vapor permeance thickness, and jackets (both factory- and field-applied, if any).
B. Shop Drawings: Include plans, elevations, sections, details, and attachments to other work.
   1. Detail application of protective shields, saddles, and inserts at hangers for each type of insulation and hanger.
   2. Detail attachment and covering of heat tracing inside insulation.
   3. Detail insulation application at pipe expansion joints for each type of insulation.
   4. Detail insulation application at elbows, fittings, flanges, valves, and specialties for each type of insulation.
   5. Detail removable insulation at piping specialties, equipment connections, and access panels.
   6. Detail application of field-applied jackets.
   7. Detail application at linkages of control devices.

1.04 INFORMATIONAL SUBMITTALS

A. Qualification Data: For qualified Installer.
B. Material Test Reports: From a qualified testing agency acceptable to authorities having jurisdiction indicating, interpreting, and certifying test results for compliance of insulation materials, sealers, attachments, cements, and jackets, with requirements indicated. Include dates of tests and test methods employed.

1.05 QUALITY ASSURANCE

A. Installer Qualifications: Skilled mechanics who have successfully completed an apprenticeship program or another craft training program certified by the Department of Labor, Bureau of Apprenticeship and Training.
B. Surface-Burning Characteristics: For insulation and related materials, as determined by testing identical products according to ASTM E 84 by a testing agency acceptable to authorities having jurisdiction. Factory label insulation and jacket materials and adhesive, mastic, tapes, and cement material containers, with appropriate markings of applicable testing agency.
   1. Insulation Installed Indoors: Flame-spread index of 25 or less, and smoke-developed index of 50 or less.
   2. Insulation Installed Outdoors: Flame-spread index of 75 or less, and smoke-developed index of 150 or less.

1.06 DELIVERY, STORAGE, AND HANDLING

A. Packaging: Insulation material containers shall be marked by manufacturer with appropriate ASTM standard designation, type and grade, and maximum use temperature.

1.07 COORDINATION

A. Coordinate sizes and locations of supports, hangers, and insulation shields specified in Section 22 0529 "Hangers and Supports for Plumbing Piping and Equipment."
B. Coordinate clearance requirements with piping Installer for piping insulation application. Before preparing piping Shop Drawings establish and maintain clearance requirements for installation of insulation and field-applied jackets and finishes and for space required for maintenance.
C. Coordinate installation and testing of heat tracing.

1.08 SCHEDULING

A. Schedule insulation application after pressure testing systems and, where required, after installing and testing heat tracing. Insulation application may begin on segments that have satisfactory test results.
B. Complete installation and concealment of plastic materials as rapidly as possible in each area of construction.

PART 2 PRODUCTS

2.01 INSULATION MATERIALS

A. Comply with requirements in "Piping Insulation Schedule, General," "Indoor Piping Insulation Schedule," "Outdoor, Aboveground Piping Insulation Schedule," and "Outdoor, Underground Piping Insulation Schedule" articles for where insulating materials shall be applied.
B. Insulation for below-ambient service requires a vapor-barrier.
C. Products shall not contain asbestos, lead, mercury, or mercury compounds.

D. Products that come in contact with stainless steel shall have a leachable chloride content of less than 50 ppm when tested according to ASTM C 871.
E. Insulation materials for use on austenitic stainless steel shall be qualified as acceptable according to ASTM C 795.
F. Foam insulation materials shall not use CFC or HCFC blowing agents in the manufacturing process.
G. Flexible Elastomeric Insulation: Closed-cell, sponge- or expanded-rubber materials. Comply with ASTM C 534, Type I for tubular materials.
    1. Products: Subject to compliance with requirements, provide one of the following:
        a. Aeroflex USA, Inc.; Aerocel.
        b. Armacell LLC; AP Armaflex.
        c. K-Flex USA; Insul-Lock, Insul-Tube, and K-FLEX LS.
H. Mineral-Fiber Blanket Insulation: Mineral or glass fibers bonded with a thermosetting resin. Comply with ASTM C 553:
    1. Type II and ASTM C 1290, Factory-applied jacket requirements are specified in "Factory-Applied Jackets" Article.
    2. Products: Subject to compliance with requirements, provide one of the following:
        a. CertainTeed Corp.; SoftTouch Duct Wrap.
        b. Johns Manville; Microlite.
        c. Knauf Insulation; Friendly Feel Duct Wrap.
        d. Manson Insulation Inc.; Alley Wrap.
        e. Owens Corning; SOFTR All-Service Duct Wrap.
I. Mineral-Fiber, Preformed Pipe Insulation:
    1. Products: Subject to compliance with requirements, provide one of the following:
        a. Fibrex Insulations Inc.; Coreplus 1200.
        b. Johns Manville; Micro-Lok.
        c. Knauf Insulation; 1000-Degree Pipe Insulation.
        d. Manson Insulation Inc.; Alley-K.
        e. Owens Corning; Fiberglas Pipe Insulation.
    2. Type I, 850 Deg F Materials: Mineral or glass fibers bonded with a thermosetting resin. Comply with ASTM C 547, Type I, Grade A,
        a. Without factory-applied jacket with factory-applied ASJ-SSL. Factory-applied jacket requirements are specified in "Factory-Applied Jackets" Article.
J. Prefabricated Thermal Insulating Fitting Covers: Comply with ASTM C 450 for dimensions used in performing insulation to cover valves, elbows, tees, and flanges.

2.02 INSULATING CEMENTS

A. Mineral-Fiber Insulating Cement: Comply with ASTM C 195.
    1. Products: Subject to compliance with requirements, provide the following:
        a. Ramco Insulation, Inc.; Super-Stik.
B. Mineral-Fiber, Hydraulic-Setting Insulating and Finishing Cement: Comply with ASTM C 449.
    1. Products: Subject to compliance with requirements, provide the following:

a. Ramco Insulation, Inc.; Super-Stik and Quik-Cote

2.03 ADHESIVES

A. Materials shall be compatible with insulation materials, jackets, and substrates and for bonding insulation to itself and to surfaces to be insulated, unless otherwise indicated.
B. Flexible Elastomeric Adhesive: Comply with MIL-A-24179A, Type II, Class I.
   1. Products: Subject to compliance with requirements, provide one of the following:
      a. Aeroflex USA, Inc.; Aeroseal.
      b. Armacell LLC; Armaflex 520 Adhesive.
      c. Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; 85-75.
      d. K-Flex USA; R-373 Contact Adhesive.
   2. For indoor applications, adhesive shall have a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
C. Mineral-Fiber Adhesive: Comply with MIL-A-3316C, Class 2, Grade A.
   1. Products: Subject to compliance with requirements, provide one of the following:
      a. Childers Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; CP-127.
      b. Eagle Bridges - Marathon Industries; 225.
      c. Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; 85-60/85-70.
      d. Mon-Eco Industries, Inc.; 22-25.
   2. For indoor applications, adhesive shall have a VOC content of 80 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
D. ASJ Adhesive, and FSK Jacket Adhesive: Comply with MIL-A-3316C, Class 2, Grade A for bonding insulation jacket lap seams and joints.
   1. Products: Subject to compliance with requirements, provide one of the following:
      a. Childers Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; CP-82.
      b. Eagle Bridges - Marathon Industries; 225.
      c. Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; 85-20.
      d. Mon-Eco Industries, Inc.; 22-25.
   2. For indoor applications, adhesive shall have a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
E. PVC Jacket Adhesive: Compatible with PVC jacket.
   1. Products: Subject to compliance with requirements, provide one of the following:
      a. Dow Corning Corporation; 739, Dow Silicone.
      b. Johns Manville; Zeston Perma-Weld, CEEL-TITE Solvent Welding Adhesive.
      c. P.I.C. Plastics, Inc.; Welding Adhesive.
      d. Speedline Corporation; Polyco VP Adhesive.

2. For indoor applications, adhesive shall have a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

2.04 MASTICS

A. Materials shall be compatible with insulation materials, jackets, and substrates; comply with MIL-PRF-19565C, Type II.
   1. For indoor applications, use mastics that have a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
B. Vapor-Barrier Mastic: Water based; suitable for indoor use on below-ambient services.
   1. Products: Subject to compliance with requirements, provide one of the following:
      a. Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; 30-80/30-90.
      b. Vimasco Corporation; 749.
   2. Water-Vapor Permeance: ASTM E 96/E 96M, Procedure B, 0.013 perm at 43-mil dry film thickness.
   3. Service Temperature Range: Minus 20 to plus 180 deg F.
   4. Solids Content: ASTM D 1644, 58 percent by volume and 70 percent by weight.
   5. Color: White.
C. Vapor-Barrier Mastic: Solvent based; suitable for indoor use on below-ambient services.
   1. Products: Subject to compliance with requirements, provide one of the following:
      a. Childers Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; CP-30.
      b. Eagle Bridges - Marathon Industries; 501.
      c. Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; 30-35.
      d. Mon-Eco Industries, Inc.; 55-10.
   2. Water-Vapor Permeance: ASTM F 1249, 0.05 perm at 35-mil dry film thickness.
   3. Service Temperature Range: 0 to 180 deg F.
   4. Solids Content: ASTM D 1644, 44 percent by volume and 62 percent by weight.
   5. Color: White.
D. Vapor-Barrier Mastic: Solvent based; suitable for outdoor use on below-ambient services.
   1. Products: Subject to compliance with requirements, provide one of the following:
      a. Childers Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; Encacel.
      b. Eagle Bridges - Marathon Industries; 570.
      c. Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; 60-95/60-96.
   2. Water-Vapor Permeance: ASTM F 1249, 0.05 perm at 30-mil dry film thickness.
   3. Service Temperature Range: Minus 50 to plus 220 deg F .
   4. Solids Content: ASTM D 1644, 33 percent by volume and 46 percent by weight.
   5. Color: White.
E. Breather Mastic: Water based; suitable for indoor and outdoor use on above-ambient services.

1. Products: Subject to compliance with requirements, provide one of the following:
   a. Childers Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; CP-10.
   b. Eagle Bridges - Marathon Industries; 550.
   c. Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; 46-50.
   d. Mon-Eco Industries, Inc.; 55-50.
   e. Vimasco Corporation; WC-1/WC-5.
2. Water-Vapor Permeance: ASTM F 1249, 1.8 perms at 0.0625-inch dry film thickness.
3. Service Temperature Range: Minus 20 to plus 180 deg F.
4. Solids Content: 60 percent by volume and 66 percent by weight.
5. Color: White.

2.05 SEALANTS

A. ASJ Flashing Sealants and PVC Jacket Flashing Sealants:
   1. Products: Subject to compliance with requirements, provide the following:
      a. Childers Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; CP-76.
   2. Materials shall be compatible with insulation materials, jackets, and substrates.
   3. Fire- and water-resistant, flexible, elastomeric sealant.
   4. Service Temperature Range: Minus 40 to plus 250 deg F.
   5. Color: White.
   6. For indoor applications, sealants shall have a VOC content of 420 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

2.06 FACTORY-APPLIED JACKETS

A. Insulation system schedules indicate factory-applied jackets on various applications. When factory-applied jackets are indicated, comply with the following:
   1. ASJ-SSL: ASJ with self-sealing, pressure-sensitive, acrylic-based adhesive covered by a removable protective strip; complying with ASTM C 1136, Type I.

2.07 FIELD-APPLIED JACKETS

A. Field-applied jackets shall comply with ASTM C 921, Type I, unless otherwise indicated.
B. PVC Jacket: High-impact-resistant, UV-resistant PVC complying with ASTM D 1784, Class 16354-C; thickness as scheduled; roll stock ready for shop or field cutting and forming. Thickness is indicated in field-applied jacket schedules.
   1. Products: Subject to compliance with requirements, provide one of the following:
      a. Johns Manville; Zeston.
      b. P.I.C. Plastics, Inc.; FG Series.
      c. Proto Corporation; LoSmoke.
      d. Speedline Corporation; SmokeSafe.
   2. Adhesive: As recommended by jacket material manufacturer.

3. Color: Color-code jackets based on system.
   a. White.
4. Factory-fabricated fitting covers to match jacket if available; otherwise, field fabricate.
   a. Shapes: 45- and 90-degree, short- and long-radius elbows, tees, valves, flanges, unions, reducers, end caps, soil-pipe hubs, traps, mechanical joints, and P-trap and supply covers for lavatories.

2.08 TAPES

A. ASJ Tape: White vapor-retarder tape matching factory-applied jacket with acrylic adhesive, complying with ASTM C 1136.
   1. Products: Subject to compliance with requirements, provide one of the following:
      a. ABI, Ideal Tape Division; 428 AWF ASJ.
      b. Avery Dennison Corporation, Specialty Tapes Division; Fasson 0836.
      c. Compac Corporation; 104 and 105.
      d. Venture Tape; 1540 CW Plus, 1542 CW Plus, and 1542 CW Plus/SQ.
   2. Width: 3 inches.
   3. Thickness: 11.5 mils.
   4. Adhesion: 90 ounces force/inch in width.
   5. Elongation: 2 percent.
   6. Tensile Strength: 40 lbf/inch in width.
   7. ASJ Tape Disks and Squares: Precut disks or squares of ASJ tape.
B. PVC Tape: White vapor-retarder tape matching field-applied PVC jacket with acrylic adhesive; suitable for indoor and outdoor applications.
   1. Products: Subject to compliance with requirements, provide one of the following:
      a. ABI, Ideal Tape Division; 370 White PVC tape.
      b. Compac Corporation; 130.
      c. Venture Tape; 1506 CW NS.
   2. Width: 2 inches.
   3. Thickness: 6 mils.
   4. Adhesion: 64 ounces force/inch in width.
   5. Elongation: 500 percent.
   6. Tensile Strength: 18 lbf/inch in width.

2.09 SECUREMENTS

A. Staples: Outward-clinching insulation staples, nominal 3/4-inch- wide, stainless steel or Monel.

2.10 PROTECTIVE SHIELDING GUARDS

A. Protective Shielding Pipe Covers:
   1. Manufacturers: Subject to compliance with requirements provide products by one of the following:
      a. Engineered Brass Company.
      b. Insul-Tect Products Co.; a subsidiary of MVG Molded Products.

c. McGuire Manufacturing.
d. Plumberex.
e. Truebro; a brand of IPS Corporation.
f. Zurn Industries, LLC; Tubular Brass Plumbing Products Operation.

2. Description: Manufactured plastic wraps for covering plumbing fixture hot- and cold-water supplies and trap and drain piping. Comply with Americans with Disabilities Act (ADA) requirements.

B. Protective Shielding Piping Enclosures:
1. Manufacturers: Subject to compliance with requirements provide products by one of the following:
a. Truebro; a brand of IPS Corporation.
b. Zurn Industries, LLC; Tubular Brass Plumbing Products Operation.
2. Description: Manufactured plastic enclosure for covering plumbing fixture hot- and cold-water supplies and trap and drain piping. Comply with ADA requirements.

PART 3 EXECUTION

3.01 EXAMINATION

A. Examine substrates and conditions for compliance with requirements for installation tolerances and other conditions affecting performance of insulation application.
1. Verify that systems to be insulated have been tested and are free of defects.
2. Verify that surfaces to be insulated are clean and dry.
B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 PREPARATION

A. Surface Preparation: Clean and dry surfaces to receive insulation. Remove materials that will adversely affect insulation application.
B. Coordinate insulation installation with the trade installing heat tracing. Comply with requirements for heat tracing that apply to insulation.
C. Mix insulating cements with clean potable water; if insulating cements are to be in contact with stainless-steel surfaces, use demineralized water.

3.03 GENERAL INSTALLATION REQUIREMENTS

A. Install insulation materials, accessories, and finishes with smooth, straight, and even surfaces; free of voids throughout the length of piping including fittings, valves, and specialties.
B. Install insulation materials, forms, vapor barriers or retarders, jackets, and thicknesses required for each item of pipe system as specified in insulation system schedules.
C. Install accessories compatible with insulation materials and suitable for the service. Install accessories that do not corrode, soften, or otherwise attack insulation or jacket in either wet or dry state.
D. Install insulation with longitudinal seams at top and bottom of horizontal runs.
E. Install multiple layers of insulation with longitudinal and end seams staggered.

F. Do not weld brackets, clips, or other attachment devices to piping, fittings, and specialties.
G. Keep insulation materials dry during application and finishing.
H. Install insulation with tight longitudinal seams and end joints. Bond seams and joints with adhesive recommended by insulation material manufacturer.
I. Install insulation with least number of joints practical.
J. Where vapor barrier is indicated, seal joints, seams, and penetrations in insulation at hangers, supports, anchors, and other projections with vapor-barrier mastic.
    1. Install insulation continuously through hangers and around anchor attachments.
    2. For insulation application where vapor barriers are indicated, extend insulation on anchor legs from point of attachment to supported item to point of attachment to structure. Taper and seal ends at attachment to structure with vapor-barrier mastic.
    3. Install insert materials and install insulation to tightly join the insert. Seal insulation to insulation inserts with adhesive or sealing compound recommended by insulation material manufacturer.
    4. Cover inserts with jacket material matching adjacent pipe insulation. Install shields over jacket, arranged to protect jacket from tear or puncture by hanger, support, and shield.
K. Apply adhesives, mastics, and sealants at manufacturer's recommended coverage rate and wet and dry film thicknesses.
L. Install insulation with factory-applied jackets as follows:
    1. Draw jacket tight and smooth.
    2. Cover circumferential joints with 3-inch wide strips, of same material as insulation jacket. Secure strips with adhesive and outward clinching staples along both edges of strip, spaced 4 inches o.c.
    3. Overlap jacket longitudinal seams at least 1-1/2 inches. Install insulation with longitudinal seams at bottom of pipe. Clean and dry surface to receive self-sealing lap. Staple laps with outward clinching staples along edge at:
        a. 2 inches o.c.
        b. For below-ambient services, apply vapor-barrier mastic over staples.
    4. Cover joints and seams with tape, according to insulation material manufacturer's written instructions, to maintain vapor seal.
    5. Where vapor barriers are indicated, apply vapor-barrier mastic on seams and joints and at ends adjacent to pipe flanges and fittings.
M. Cut insulation in a manner to avoid compressing insulation more than 75 percent of its nominal thickness.
N. Finish installation with systems at operating conditions. Repair joint separations and cracking due to thermal movement.
O. Repair damaged insulation facings by applying same facing material over damaged areas. Extend patches at least 4 inches beyond damaged areas. Adhere, staple, and seal patches similar to butt joints.
P. For above-ambient services, do not install insulation to the following:
    1. Vibration-control devices.
    2. Testing agency labels and stamps.
    3. Nameplates and data plates.

4. Cleanouts.

3.04 PENETRATIONS

A. Insulation Installation at Roof Penetrations: Install insulation continuously through roof penetrations.
   1. Seal penetrations with flashing sealant.
   2. For applications requiring only indoor insulation, terminate insulation above roof surface and seal with joint sealant. For applications requiring indoor and outdoor insulation, install insulation for outdoor applications tightly joined to indoor insulation ends. Seal joint with joint sealant.
   3. Extend jacket of outdoor insulation outside roof flashing at least 2 inches below top of roof flashing.
   4. Seal jacket to roof flashing with flashing sealant.
B. Insulation Installation at Underground Exterior Wall Penetrations: Terminate insulation flush with sleeve seal. Seal terminations with flashing sealant.
C. Insulation Installation at Aboveground Exterior Wall Penetrations: Install insulation continuously through wall penetrations.
   1. Seal penetrations with flashing sealant.
   2. For applications requiring only indoor insulation, terminate insulation inside wall surface and seal with joint sealant. For applications requiring indoor and outdoor insulation, install insulation for outdoor applications tightly joined to indoor insulation ends. Seal joint with joint sealant.
   3. Extend jacket of outdoor insulation outside wall flashing and overlap wall flashing at least 2 inches.
   4. Seal jacket to wall flashing with flashing sealant.
D. Insulation Installation at Interior Wall and Partition Penetrations (That Are Not Fire Rated): Install insulation continuously through walls and partitions.
E. Insulation Installation at Fire-Rated Wall and Partition Penetrations: Install insulation continuously through penetrations of fire-rated walls and partitions.
   1. Comply with requirements in Section 078413 "Penetration Firestopping" for firestopping and fire-resistive joint sealers.
F. Insulation Installation at Floor Penetrations:
   1. Pipe: Install insulation continuously through floor penetrations.
   2. Seal penetrations through fire-rated assemblies. Comply with requirements in Section 078413 "Penetration Firestopping."

3.05 GENERAL PIPE INSULATION INSTALLATION

A. Requirements in this article generally apply to all insulation materials except where more specific requirements are specified in various pipe insulation material installation articles.
B. Insulation Installation on Fittings, Valves, Strainers, Flanges, and Unions:
   1. Install insulation over fittings, valves, strainers, flanges, unions, and other specialties with continuous thermal and vapor-retarder integrity unless otherwise indicated.

2. Insulate pipe elbows using preformed fitting insulation or mitered fittings made from same material and density as adjacent pipe insulation. Each piece shall be butted tightly against adjoining piece and bonded with adhesive. Fill joints, seams, voids, and irregular surfaces with insulating cement finished to a smooth, hard, and uniform contour that is uniform with adjoining pipe insulation.
3. Insulate tee fittings with preformed fitting insulation or sectional pipe insulation of same material and thickness as used for adjacent pipe. Cut sectional pipe insulation to fit. Butt each section closely to the next and hold in place with tie wire. Bond pieces with adhesive.
4. Insulate valves using preformed fitting insulation or sectional pipe insulation of same material, density, and thickness as used for adjacent pipe. Overlap adjoining pipe insulation by not less than two times the thickness of pipe insulation, or one pipe diameter, whichever is thicker. For valves, insulate up to and including the bonnets, valve stuffing-box studs, bolts, and nuts. Fill joints, seams, and irregular surfaces with insulating cement.
5. Insulate strainers using preformed fitting insulation or sectional pipe insulation of same material, density, and thickness as used for adjacent pipe. Overlap adjoining pipe insulation by not less than two times the thickness of pipe insulation, or one pipe diameter, whichever is thicker. Fill joints, seams, and irregular surfaces with insulating cement. Insulate strainers so strainer basket flange or plug can be easily removed and replaced without damaging the insulation and jacket. Provide a removable reusable insulation cover. For below-ambient services, provide a design that maintains vapor barrier.
6. Insulate flanges and unions using a section of oversized preformed pipe insulation. Overlap adjoining pipe insulation by not less than two times the thickness of pipe insulation, or one pipe diameter, whichever is thicker.
7. Cover segmented insulated surfaces with a layer of finishing cement and coat with a mastic. Install vapor-barrier mastic for below-ambient services and a breather mastic for above-ambient services. Reinforce the mastic with fabric-reinforcing mesh. Trowel the mastic to a smooth and well-shaped contour.
8. For services not specified to receive a field-applied jacket except for flexible install fitted PVC cover over elbows, tees, strainers, valves, flanges, and unions. Terminate ends with PVC end caps. Tape PVC covers to adjoining insulation facing using PVC tape.
9. Stencil or label the outside insulation jacket of each union with the word "union." Match size and color of pipe labels.

C. Insulate instrument connections for thermometers, pressure gages, pressure temperature taps, test connections, flow meters, sensors, switches, and transmitters on insulated pipes. Shape insulation at these connections by tapering it to and around the connection with insulating cement and finish with finishing cement, mastic, and flashing sealant.

D. Install removable insulation covers at locations indicated. Installation shall conform to the following:
1. Make removable flange and union insulation from sectional pipe insulation of same thickness as that on adjoining pipe. Install same insulation jacket as adjoining pipe insulation.

2. When flange and union covers are made from sectional pipe insulation, extend insulation from flanges or union long at least two times the insulation thickness over adjacent pipe insulation on each side of flange or union. Secure flange cover in place with stainless-steel or aluminum bands. Select band material compatible with insulation and jacket.
3. Construct removable valve insulation covers in same manner as for flanges, except divide the two-part section on the vertical center line of valve body.
4. When covers are made from block insulation, make two halves, each consisting of mitered blocks wired to stainless-steel fabric. Secure this wire frame, with its attached insulation, to flanges with tie wire. Extend insulation at least 2 inches over adjacent pipe insulation on each side of valve. Fill space between flange or union cover and pipe insulation with insulating cement. Finish cover assembly with insulating cement applied in two coats. After first coat is dry, apply and trowel second coat to a smooth finish.
5. Unless a PVC jacket is indicated in field-applied jacket schedules, finish exposed surfaces with a metal jacket.

3.06 INSTALLATION OF FLEXIBLE ELASTOMERIC INSULATION

A. Seal longitudinal seams and end joints with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.
B. Insulation Installation on Pipe Flanges:
   1. Install pipe insulation to outer diameter of pipe flange.
   2. Make width of insulation section same as overall width of flange and bolts, plus twice the thickness of pipe insulation.
   3. Fill voids between inner circumference of flange insulation and outer circumference of adjacent straight pipe segments with cut sections of sheet insulation of same thickness as pipe insulation.
   4. Secure insulation to flanges and seal seams with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.
C. Insulation Installation on Pipe Fittings and Elbows:
   1. Install mitered sections of pipe insulation.
   2. Secure insulation materials and seal seams with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.
D. Insulation Installation on Valves and Pipe Specialties:
   1. Install preformed valve covers manufactured of same material as pipe insulation when available.
   2. When preformed valve covers are not available, install cut sections of pipe and sheet insulation to valve body. Arrange insulation to permit access to packing and to allow valve operation without disturbing insulation.
   3. Install insulation to flanges as specified for flange insulation application.
   4. Secure insulation to valves and specialties and seal seams with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

3.07 INSTALLATION OF MINERAL-FIBER INSULATION

A. Insulation Installation on Straight Pipes and Tubes:
   1. Secure each layer of preformed pipe insulation to pipe with wire or bands and tighten bands without deforming insulation materials.
   2. Where vapor barriers are indicated, seal longitudinal seams, end joints, and protrusions with vapor-barrier mastic and joint sealant.
   3. For insulation with factory-applied jackets on above-ambient surfaces, secure laps with outward clinched staples at 6 inches o.c.
   4. For insulation with factory-applied jackets on below-ambient surfaces, do not staple longitudinal tabs. Instead, secure tabs with additional adhesive as recommended by insulation material manufacturer and seal with vapor-barrier mastic and flashing sealant.

B. Insulation Installation on Pipe Flanges:
   1. Install preformed pipe insulation to outer diameter of pipe flange.
   2. Make width of insulation section same as overall width of flange and bolts, plus twice the thickness of pipe insulation.
   3. Fill voids between inner circumference of flange insulation and outer circumference of adjacent straight pipe segments with mineral-fiber blanket insulation.
   4. Install jacket material with manufacturer's recommended adhesive, overlap seams at least 1 inch , and seal joints with flashing sealant.

C. Insulation Installation on Pipe Fittings and Elbows:
   1. Install preformed sections of same material as straight segments of pipe insulation when available.
   2. When preformed insulation elbows and fittings are not available, install mitered sections of pipe insulation, to a thickness equal to adjoining pipe insulation. Secure insulation materials with wire or bands.

D. Insulation Installation on Valves and Pipe Specialties:
   1. Install preformed sections of same material as straight segments of pipe insulation when available.
   2. When preformed sections are not available, install mitered sections of pipe insulation to valve body.
   3. Arrange insulation to permit access to packing and to allow valve operation without disturbing insulation.
   4. Install insulation to flanges as specified for flange insulation application.

3.08 FIELD-APPLIED JACKET INSTALLATION

A. Where PVC jackets are indicated, install with 1-inch overlap at longitudinal seams and end joints. Seal with manufacturer's recommended adhesive.
   1. Apply two continuous beads of adhesive to seams and joints, one bead under lap and the finish bead along seam and joint edge.

3.09 PIPING INSULATION SCHEDULE, GENERAL

A. Acceptable preformed pipe and tubular insulation materials and thicknesses are identified for each piping system and pipe size range. If more than one material is listed for a piping system, selection from materials listed is Contractor's option.
B. Insulation shall have a k value that meets the minimum requirements of the latest International Energy Conservation Code (IECC).
C. Items Not Insulated: Unless otherwise indicated, do not install insulation on the following:
   1. Drainage piping located in crawl spaces.
   2. Underground piping.
   3. Chrome-plated pipes and fittings unless there is a potential for personnel injury.

3.10 INDOOR PIPING INSULATION SCHEDULE

A. Domestic Cold Water:
   1. NPS 1-1/2 and Smaller: Insulation shall be one of the following;
      a. Flexible Elastomeric:
         1) 1 inch thick
      b. Mineral-Fiber, Preformed Pipe Insulation, Type I:
         1) 1 inch thick
   2. NPS 2 and Larger: Insulation shall be one of the following:
      a. Flexible Elastomeric:
         1) 1-1/2 inches thick.
      b. Mineral-Fiber, Preformed Pipe Insulation:
         1) 1-1/2 inches thick.
B. Domestic Hot and Recirculated Hot Water:
   1. NPS 1-1/2 and Smaller: Insulation shall be the following:
      a. Mineral-Fiber, Preformed Pipe Insulation, Type I:
         1) 1 inch thick.
   2. NPS 2 and Larger: Insulation shall be the following:
      a. Mineral-Fiber, Preformed Pipe Insulation, Type I:
         1) 1-1/2 inches thick
C. Roof Drain and Secondary Roof Drain Piping:
   1. All Pipe Sizes: Insulation shall be one of the following:
      a. Flexible Elastomeric: 1 inch thick.
      b. Mineral-Fiber, Preformed Pipe Insulation, Type I: 1 inch thick.
D. Roof Drain and Secondary Drain Bodies:
   1. All Pipe Sizes: Insulation shall be one of the following:
      a. Flexible Elastomeric: 1 inch thick.
      b. Mineral-Fiber, Blanket Insulation, Type I: 1 inch thick.
      c. Drain Manufacturer’s Pre-formed bowl Insulation: 1 inch thick.
E. Floor Drains, Traps, and Sanitary Drain Piping within 10 Feet of Drain Receiving Condensate and Equipment Drain Water below 60 Deg F:
   1. All Pipe Sizes: Insulation shall be one of the following:

a. Flexible Elastomeric:
   1) 3/4 inch thick.
b. Mineral-Fiber, Preformed Pipe Insulation, Type I:
   1) 3/4 inch thick.

3.11 INDOOR, FIELD-APPLIED JACKET SCHEDULE

A. Install jacket over insulation material. For insulation with factory-applied jacket, install the field-applied jacket over the factory-applied jacket.
B. If more than one material is listed, selection from materials listed is Contractor's option.
C. Piping, Concealed: None
D. Piping, Exposed:
   1. PVC:
      a. White: 30 mils thick

3.12 UNDERGROUND, FIELD-INSTALLED INSULATION JACKET

A. For underground direct-buried piping applications, install underground direct-buried jacket over insulation material.

END OF SECTION 22 0719

SECTION 22 1114 - NATURAL GAS PIPING AND SPECIALTIES

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Furnish all labor, materials, equipment, tools and services required to fully complete all Gas Piping work as is indicated on the drawings and/or specified herein including, but not limited to, the following described items.
   1. Pipes, tubes, and fittings.
   2. Piping specialties.
   3. Piping and tubing joining materials.
   4. Valves.
   5. Pressure regulators.
   6. Mechanical sleeve seals.
   7. Grout.
   8. Concrete bases.
   9. This division is to pay all costs associated with the gas meter that are required by the local gas company/authority.

1.02 DEFINITIONS

A. Finished Spaces: Spaces other than mechanical and electrical equipment rooms, furred spaces, pipe and duct shafts, unheated spaces immediately below roof, spaces above ceilings, unexcavated spaces, crawlspaces, and tunnels.
B. Exposed, Interior Installations: Exposed to view indoors. Examples include finished occupied spaces and mechanical equipment rooms.
C. Exposed, Exterior Installations: Exposed to view outdoors or subject to outdoor ambient temperatures and weather conditions. Examples include rooftop locations.

1.03 PERFORMANCE REQUIREMENTS

A. Minimum Operating-Pressure Ratings:
   1. Piping and Valves: 100 psig minimum unless otherwise indicated.
B. Natural-Gas System Pressures within Buildings: Two pressure ranges. Primary pressure is more than 2 psig but not more than 5 psig, and is reduced to secondary pressure of more than 0.5 psig but not more than 2 psig.
C. Delegated Design: Design restraints and anchors for natural-gas piping and equipment, including comprehensive engineering analysis by a qualified professional engineer, using performance requirements and design criteria indicated.

1.04 SUBMITTALS

A. Product Data: For each type of the following:
   1. Piping specialties.

2. Valves. Include pressure rating, capacity and settings of selected models.
3. Pressure regulators. Indicate pressure ratings and capacities.
4. Dielectric fittings.
5. Mechanical sleeve seals.
6. Escutcheons.

B. Shop Drawings: For facility natural-gas piping layout. Include plans, piping layout and elevations, sections, and details for fabrication of pipe anchors, hangers, supports for multiple pipes, alignment guides, expansion joints and loops, and attachments of the same to building structure. Detail location of anchors, alignment guides, and expansion joints and loops.
   1. Shop Drawing Scale: 1/4 inch per foot.
C. Coordination Drawings: Plans and details, drawn to scale, on which natural-gas piping is shown and coordinated with other installations, using input from installers of the items involved.
D. Site Survey: Plans, drawn to scale, on which natural-gas piping is shown and coordinated with other services and utilities.
E. Qualification Data: For qualified professional engineer.
F. Welding certificates.
G. Field quality-control reports.
H. Operation and Maintenance Data: For pressure regulators to include in emergency, operation, and maintenance manuals.

1.05 QUALITY ASSURANCE

A. Steel Support Welding Qualifications: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."
B. Pipe Welding Qualifications: Qualify procedures and operators according to ASME Boiler and Pressure Vessel Code.

1.06 DELIVERY, STORAGE, AND HANDLING

A. Handling Flammable Liquids: Remove and dispose of liquids from existing natural-gas piping according to requirements of authorities having jurisdiction.
B. Deliver pipes and tubes with factory-applied end caps. Maintain end caps through shipping, storage, and handling to prevent pipe end damage and to prevent entrance of dirt, debris, and moisture.
C. Store and handle pipes and tubes having factory-applied protective coatings to avoid damaging coating, and protect from direct sunlight.
D. Protect stored PE pipes and valves from direct sunlight.

1.07 COORDINATION

A. Coordinate sizes and locations of concrete bases with actual equipment provided.
B. Coordinate requirements for access panels and doors for valves installed concealed behind finished surfaces. Comply with requirements in Division 08 Section "Access Doors and Frames."

PART 2 PRODUCTS

2.01 PIPES, TUBES, AND FITTINGS

A. Steel Pipe: ASTM A 53/A 53M, black steel, Schedule 40, Type E or S, Grade B.
   1. Malleable-Iron Threaded Fittings: ASME B16.3, Class 150, standard pattern.
   2. Wrought-Steel Welding Fittings: ASTM A 234/A 234M for butt welding and socket welding.
   3. Unions: ASME B16.39, Class 150, malleable iron with brass-to-iron seat, ground joint, and threaded ends.
   4. Forged-Steel Flanges and Flanged Fittings: ASME B16.5, minimum Class 150, including bolts, nuts, and gaskets of the following material group, end connections, and facings:
      a. Material Group: 1.1.
      b. End Connections: Threaded or butt welding to match pipe.
      c. Lapped Face: Not permitted underground.
      d. Gasket Materials: ASME B16.20, metallic, flat, asbestos free, aluminum o-rings, and spiral-wound metal gaskets.
      e. Bolts and Nuts: ASME B18.2.1, carbon steel aboveground and stainless steel underground.

2.02 PIPING SPECIALTIES

A. Appliance Flexible Connectors:
   1. Indoor, Fixed-Appliance Flexible Connectors: Comply with ANSI Z21.24.
   2. Indoor, Movable-Appliance Flexible Connectors: Comply with ANSI Z21.69.
   3. Corrugated stainless-steel tubing with polymer coating.
   4. Operating-Pressure Rating: 0.5 psig.
   5. End Fittings: Zinc-coated steel.
   6. Threaded Ends: Comply with ASME B1.20.1.
   7. Maximum Length: 72 inches.
B. Weatherproof Vent Cap: Cast- or malleable-iron increaser fitting with corrosion-resistant wire screen, with free area at least equal to cross-sectional area of connecting pipe and threaded-end connection.

2.03 JOINING MATERIALS

A. Joint Compound and Tape: Suitable for natural gas.
B. Welding Filler Metals: Comply with AWS D10.12/D10.12M for welding materials appropriate for wall thickness and chemical analysis of steel pipe being welded.

2.04 MANUAL GAS SHUTOFF VALVES

A. One-Piece, Brass Ball Valve with Stainless Steel Trim: MSS SP-110.
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Apollo
b. Milwaukee
c. Conbraco Industries, Inc.; Apollo Div.
d. McDonald, A. Y. Mfg. Co.
e. Perfection Corporation; a subsidiary of American Meter Company.

2. Body: Brass, complying with ASTM B283.
3. Ball: Brass
4. Stem: Brass ASTM B124.
5. Seats: Reinforced PTFE; blowout proof.
6. Packing: Separate packnut with adjustable-stem packing threaded ends.
7. Ends: Threaded, flared, or socket as indicated in "Underground Manual Gas Shutoff Valve Schedule" and "Aboveground Manual Gas Shutoff Valve Schedule" Articles.
8. CWP Rating: 400 psig.
9. Listing: Valves NPS 1 and smaller shall be listed and labeled by an NRTL acceptable to authorities having jurisdiction. UL, FM and CSA listed for natural gas service.
10. Service: Suitable for natural-gas service with "WOG" indicated on valve body.

B. Two-Piece, Full-Port, Brass Ball Valves with Stainless Steel Trim: MSS SP-110.
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
a. Apollo
b. Milwaukee
c. Conbraco Industries, Inc.; Apollo Div.
d. McDonald, A. Y. Mfg. Co.
e. Perfection Corporation; a subsidiary of American Meter Company.
2. Body: Brass, complying with ASTM B283
3. Ball: Brass
4. Stem: Brass ASTM B124
5. Seats: Reinforced PTFE; blowout proof.
6. Packing: Threaded-body packnut design with adjustable-stem packing.
7. Ends: Threaded, flared, or socket as indicated in "Underground Manual Gas Shutoff Valve Schedule" and "Aboveground Manual Gas Shutoff Valve Schedule" Articles.
8. CWP Rating: 400 psig.
9. Listing: Valves NPS 1 and smaller shall be listed and labeled by an NRTL acceptable to authorities having jurisdiction. UL, FM and CSA listed for natural gas service.
10. Service: Suitable for natural-gas service with "WOG" indicated on valve body.

2.05 PRESSURE REGULATORS

A. General Requirements:
1. Single stage and suitable for natural gas.
2. Steel jacket and corrosion-resistant components.
3. Elevation compensator.

4. End Connections: Threaded for regulators NPS 2 and smaller; flanged for regulators NPS 2-1/2 and larger.

B. Line Pressure Regulators: Comply with ANSI Z21.80.
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
a. Actaris.
b. American Meter Company.
c. Eclipse Combustion, Inc.
d. Fisher Control Valves and Regulators; Division of Emerson Process Management.
e. Invensys.
f. Maxitrol Company.
g. Richards Industries; Jordan Valve Div.
2. Body and Diaphragm Case: Cast iron or die-cast aluminum.
3. Springs: Zinc-plated steel; interchangeable.
4. Diaphragm Plate: Zinc-plated steel.
5. Seat Disc: Nitrile rubber resistant to gas impurities, abrasion, and deformation at the valve port.
6. Orifice: Aluminum; interchangeable.
7. Seal Plug: Ultraviolet-stabilized, mineral-filled nylon.
8. Single-port, self-contained regulator with orifice no larger than required at maximum pressure inlet, and no pressure sensing piping external to the regulator.
9. Pressure regulator shall maintain discharge pressure setting downstream, and not exceed 150 percent of design discharge pressure at shutoff.
10. Overpressure Protection Device: Factory mounted on pressure regulator.
11. Atmospheric Vent: Factory- or field-installed, stainless-steel screen in opening if not connected to vent piping.
12. Maximum Inlet Pressure: 5 psig.

2.06 DIELECTRIC FITTINGS

A. Dielectric Unions:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
a. Capitol Manufacturing Company.
b. Central Plastics Company.
c. Hart Industries International, Inc.
d. McDonald, A. Y. Mfg. Co.
e. Watts Regulator Co.; Division of Watts Water Technologies, Inc.
f. Wilkins; Zurn Plumbing Products Group.
2. Minimum Operating-Pressure Rating: 150 psig.
3. Combination fitting of copper alloy and ferrous materials.
4. Insulating materials suitable for natural gas.

5. Combination fitting of copper alloy and ferrous materials with threaded, brazed-joint, plain, or welded end connections that match piping system materials.

B. Dielectric-Flange Kits:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
a. Advance Products & Systems, Inc.
b. Calpico Inc.
c. Central Plastics Company.
d. Pipeline Seal and Insulator, Inc.
2. Minimum Operating-Pressure Rating: 150 psig.
3. Companion-flange assembly for field assembly.
4. Include flanges, full-face- or ring-type neoprene or phenolic gasket, phenolic or PE bolt sleeves, phenolic washers, and steel backing washers.
5. Insulating materials suitable for natural gas.
6. Combination fitting of copper alloy and ferrous materials with threaded, brazed-joint, plain, or welded end connections that match piping system materials.

2.07 SLEEVES

A. Steel Pipe Sleeves: ASTM A 53/A 53M, Type E, Grade B, Schedule 40, galvanized steel, plain ends.
B. Cast-Iron Pipe Sleeves: Cast or fabricated "wall pipe," equivalent to ductile-iron pressure pipe, with plain ends and integral waterstop, unless otherwise indicated.

2.08 MECHANICAL SLEEVE SEALS

A. Description: Modular sealing element unit, designed for field assembly, to fill annular space between pipe and sleeve.
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
a. Advance Products & Systems, Inc.
b. Calpico Inc.
c. Metraflex Company (The).
d. Pipeline Seal and Insulator, Inc.
2. Sealing Elements: EPDM interlocking links shaped to fit surface of pipe. Include type and number required for pipe material and size of pipe and sleeve.
3. Pressure Plates: Stainless steel.
4. Connecting Bolts and Nuts: Stainless steel of length required to secure pressure plates to sealing elements. Include one nut and bolt for each sealing element.

2.09 ESCUTCHEONS

A. General Requirements for Escutcheons: Manufactured wall and ceiling escutcheons and floor plates, with ID to fit around pipe or tube, and OD that completely covers opening.

B. One-Piece, Deep-Pattern Escutcheons: Deep-drawn, box-shaped brass with polished chrome-plated finish.
C. One-Piece, Cast-Brass Escutcheons: With set screw.
   1. Finish: Polished chrome-plated or rough brass.
D. Split-Casting, Cast-Brass Escutcheons: With concealed hinge and set screw.
   1. Finish: Polished chrome-plated or rough brass.
E. One-Piece, Stamped-Steel Escutcheons: With set screw or spring clips and chrome-plated finish.
F. Split-Plate, Stamped-Steel Escutcheons: With concealed hinge, set screw or spring clips, and chrome-plated finish.
G. One-Piece, Floor-Plate Escutcheons: Cast-iron floor plate.
H. Split-Casting, Floor-Plate Escutcheons: Cast brass with concealed hinge and set screw.

2.10 GROUT

A. Description: ASTM C 1107, Grade B, nonshrink and nonmetallic, dry hydraulic-cement grout.
   1. Characteristics: Post-hardening, volume adjusting, nonstaining, noncorrosive, nongaseous, and recommended for interior and exterior applications.
   2. Design Mix: 5000-psi, 28-day compressive strength.
   3. Packaging: Premixed and factory packaged.

2.11 LABELING AND IDENTIFYING

A. Detectable Warning Tape: Acid- and alkali-resistant, PE film warning tape manufactured for marking and identifying underground utilities, a minimum of 6 inches wide and 4 mils thick, continuously inscribed with a description of utility, with metallic core encased in a protective jacket for corrosion protection, detectable by metal detector when tape is buried up to 30 inches deep; colored yellow.

PART 3 EXECUTION

3.01 EXAMINATION

A. Examine roughing-in for natural-gas piping system to verify actual locations of piping connections before equipment installation.
B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 PREPARATION

A. Close equipment shutoff valves before turning off natural gas to premises or piping section.
B. Inspect natural-gas piping according to the International Fuel Gas Code to determine that natural-gas utilization devices are turned off in piping section affected.
C. Comply with the International Fuel Gas Code requirements for prevention of accidental ignition.

3.03 INDOOR PIPING INSTALLATION

A. Comply with the International Fuel Gas Code for installation and purging of natural-gas piping.
B. Drawing plans, schematics, and diagrams indicate general location and arrangement of piping systems. Indicated locations and arrangements are used to size pipe and calculate friction loss, expansion, and other design considerations. Install piping as indicated unless deviations to layout are approved on Coordination Drawings.
C. Arrange for pipe spaces, chases, slots, sleeves, and openings in building structure during progress of construction, to allow for mechanical installations.
D. Install piping in concealed locations unless otherwise indicated and except in equipment rooms and service areas.
E. Install piping indicated to be exposed and piping in equipment rooms and service areas at right angles or parallel to building walls. Diagonal runs are prohibited unless specifically indicated otherwise.
F. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal.
G. Locate valves for easy access.
H. Install natural-gas piping at uniform grade of 2 percent down toward drip and sediment traps.
I. Install piping free of sags and bends.
J. Install fittings for changes in direction and branch connections.
K. Install escutcheons at penetrations of interior walls, ceilings, and floors.
    1. New Piping:
        a. Piping with Fitting or Sleeve Protruding from Wall: One-piece, deep-pattern type.
        b. Piping at Wall and Floor Penetrations in Finished Spaces: One-piece, cast-brass type with polished chrome-plated finish.
        c. Piping at Wall and Floor Penetrations in Finished Spaces: One-piece, stamped-steel type.
        d. Piping at Ceiling Penetrations in Finished Spaces: One-piece or split-casting, cast-brass type with polished chrome-plated finish.
        e. Piping at Ceiling Penetrations in Finished Spaces: One-piece, stamped-steel type or split-plate, stamped-steel type with concealed hinge and set screw.
        f. Piping in Unfinished Service Spaces: One-piece, cast-brass type with polished chrome-plated finish.
        g. Piping in Unfinished Service Spaces: One-piece, stamped-steel type with set screw or spring clips.
        h. Piping in Equipment Rooms: One-piece, cast-brass type.
        i. Piping in Equipment Rooms: One-piece, stamped-steel type with set screw or spring clips.
        j. Piping at Floor Penetrations in Equipment Rooms: One-piece, floor-plate type.
L. Fire-Barrier Penetrations: Maintain indicated fire rating of walls, partitions, ceilings, and floors at pipe penetrations. Seal pipe penetrations with firestop materials. Comply with requirements in Division 07 Section "Penetration Firestopping."
M. Verify final equipment locations for roughing-in.

N. Comply with requirements in Sections specifying gas-fired appliances and equipment for roughing-in requirements.
O. Drips and Sediment Traps: Install drips at points where condensate may collect, including service-meter outlets. Locate where accessible to permit cleaning and emptying. Do not install where condensate is subject to freezing.
    1. Construct drips and sediment traps using tee fitting with bottom outlet plugged or capped. Use nipple a minimum length of 3 pipe diameters, but not less than 3 inches long and same size as connected pipe. Install with space below bottom of drip to remove plug or cap.
P. Extend relief vent connections for service regulators, line regulators, and overpressure protection devices to outdoors and terminate with weatherproof vent cap.
Q. Conceal pipe installations in walls, pipe spaces, utility spaces, above ceilings, below grade or floors, and in floor channels unless indicated to be exposed to view.
R. Use eccentric reducer fittings to make reductions in pipe sizes. Install fittings with level side down.
S. Connect branch piping from top or side of horizontal piping.
T. Install unions in pipes NPS 2 and smaller, adjacent to each valve, at final connection to each piece of equipment. Unions are not required at flanged connections.
U. Do not use natural-gas piping as grounding electrode.
V. Install strainer on inlet of each line-pressure regulator and automatic or electrically operated valve.
W. Install pressure gage upstream and downstream from each line regulator. Pressure gages are specified in Division 23 Section "Meters and Gages for HVAC Piping."

3.04 VALVE INSTALLATION

A. Install manual gas shutoff valve for each gas appliance ahead of corrugated stainless-steel tubing, aluminum, or copper connector.
B. Install regulators and overpressure protection devices with maintenance access space adequate for servicing and testing.
C. Install earthquake valves aboveground outside buildings according to listing.

3.05 PIPING JOINT CONSTRUCTION

A. Ream ends of pipes and tubes and remove burrs.
B. Remove scale, slag, dirt, and debris from inside and outside of pipe and fittings before assembly.
C. Welded Joints:
    1. Construct joints according to AWS D10.12/D10.12M, using qualified processes and welding operators.
    2. Bevel plain ends of steel pipe.
    3. Patch factory-applied protective coating as recommended by manufacturer at field welds and where damage to coating occurs during construction.

D. Flanged Joints: Install gasket material, size, type, and thickness appropriate for natural-gas service. Install gasket concentrically positioned.
E. PE Piping Heat-Fusion Joints: Clean and dry joining surfaces by wiping with clean cloth or paper towels. Join according to ASTM D 2657.
   1. Plain-End Pipe and Fittings: Use butt fusion.
   2. Plain-End Pipe and Socket Fittings: Use socket fusion.

3.06 HANGER AND SUPPORT INSTALLATION

A. Install seismic restraints on piping. Comply with requirements for seismic-restraint devices specified in Division 23 Section "Vibration and Seismic Controls for HVAC Piping and Equipment."
B. Comply with requirements for pipe hangers and supports specified in Division 23 Section "Hangers and Supports for HVAC Piping and Equipment."
C. Install hangers for horizontal steel piping with the following maximum spacing and minimum rod sizes:
   1. NPS 1 and Smaller: Maximum span, 96 inches; minimum rod size, 3/8 inch.
   2. NPS 1-1/4: Maximum span, 108 inches; minimum rod size, 3/8 inch.
   3. NPS 1-1/2 and NPS 2: Maximum span, 108 inches; minimum rod size, 3/8 inch.
   4. NPS 2-1/2 to NPS 3-1/2: Maximum span, 10 feet; minimum rod size, 1/2 inch.
   5. NPS 4 and Larger: Maximum span, 10 feet; minimum rod size, 5/8 inch.

3.07 CONNECTIONS

A. Connect to utility's gas main according to utility's procedures and requirements.
B. Install natural-gas piping electrically continuous, and bonded to gas appliance equipment grounding conductor of the circuit powering the appliance according to NFPA 70.
C. Install piping adjacent to appliances to allow service and maintenance of appliances.
D. Connect piping to appliances using manual gas shutoff valves and unions. Install valve within 72 inches of each gas-fired appliance and equipment. Install union between valve and appliances or equipment.
E. Sediment Traps: Install tee fitting with capped nipple in bottom to form drip, as close as practical to inlet of each appliance.

3.08 LABELING AND IDENTIFYING

A. Comply with requirements in Division 23 Section "Identification for HVAC Piping and Equipment" for piping and valve identification.

3.09 PAINTING

A. Comply with requirements in Division 09 painting Sections for painting interior and exterior natural-gas piping.

B. Paint exposed, exterior metal piping, valves, service regulators, service meters and meter bars, earthquake valves, and piping specialties, except components, with factory-applied paint or protective coating.
   1. Alkyd System: MPI EXT 5.1D.
      a. Prime Coat: Alkyd anticorrosive metal primer.
      b. Intermediate Coat: Exterior alkyd enamel matching topcoat.
      c. Topcoat: Exterior alkyd enamel (semigloss).
      d. Color: Gray.

C. Paint exposed, interior metal piping, valves, service regulators, service meters and meter bars, earthquake valves, and piping specialties, except components, with factory-applied paint or protective coating.
   1. Latex Over Alkyd Primer System: MPI INT 5.1Q.
      a. Prime Coat: Quick-drying alkyd metal primer.
      b. Intermediate Coat: Interior latex matching topcoat.
      c. Topcoat: Interior latex (flat).
      d. Color: Gray.
   2. Alkyd System: MPI INT 5.1E.
      a. Prime Coat: Quick-drying alkyd metal primer.
      b. Intermediate Coat: Interior alkyd matching topcoat.
      c. Topcoat: Interior alkyd (flat).
      d. Color: Gray.

D. Damage and Touchup: Repair marred and damaged factory-applied finishes with materials and by procedures to match original factory finish.

3.10 CONCRETE BASES

A. Concrete Bases: Anchor equipment to concrete base.
   1. Construct concrete bases of dimensions indicated, but not less than 4 inches larger in both directions than supported unit.
   2. 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 the base.
   3. Install epoxy-coated anchor bolts for supported equipment that extend through concrete base, and anchor into structural concrete floor.
   4. Place and secure anchorage devices. Use supported equipment manufacturer's setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
   5. Install anchor bolts to elevations required for proper attachment to supported equipment.
   6. Use 3000-psig 28-day, compressive-strength concrete and reinforcement as specified in Division 03 Section "Cast-in-Place Concrete."

3.11 FIELD QUALITY CONTROL

A. Perform tests and inspections.
B. Tests and Inspections:

1. Test, inspect, and purge natural gas according to the International Fuel Gas Code and authorities having jurisdiction.

C. Natural-gas piping will be considered defective if it does not pass tests and inspections.

D. Prepare test and inspection reports.

3.12 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain earthquake valves.

3.13 INDOOR PIPING SCHEDULE

A. Aboveground, piping NPS 2 and smaller shall be the following:
   1. Steel pipe with wrought-steel fittings and welded or threaded joints.

B. Aboveground, piping NPS 2-1/2” and larger shall be the following:
   1. Steel pipe with wrought-steel fittings and welded joints.

3.14 ABOVEGROUND MANUAL GAS SHUTOFF VALVE SCHEDULE

A. Valves for pipe sizes NPS 2 and smaller at service meter shall be one of the following:
   1. One-piece, bronze ball valve with stainless steel trim.

B. Valves for pipe sizes NPS 2-1/2 and larger at service meter shall be one of the following:
   1. Two-piece, bronze ball valve with stainless steel trim.

END OF SECTION 22 1114

SECTION 22 1116 - DOMESTIC WATER PIPING

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Furnish all labor, materials, equipment, tools and services required to fully complete all Domestic Water Pipe work as is indicated on the drawings and/or specified herein including, but not limited to, the following described items.
   1. Under-building-slab and aboveground domestic water pipes, tubes, and fittings inside buildings.
   2. Encasement for piping.

1.02 RELATED REQUIREMENTS

A. Division 33 Section "Facility Water Distribution Piping" for water-service piping outside the building from source to the point where water-service piping enters the building.

1.03 SEISMIC REQUIREMENTS

A. Seismic Performance: Pipe hangers and supports shall withstand the effects of earthquake motions determined according to SEI/ASCE 7 and with the requirements specified in Section 23 0548 "Vibration and Seismic Controls for HVAC."
   1. For piping with a seismic importance factor of 1.0 the term "withstand" means "the system will remain in place without separation of any parts when subjected to the seismic forces specified."

1.04 ACTION SUBMITTALS

A. Product Data: For transition fittings and dielectric fittings.
B. Delegated-Design Submittal:
   1. Design calculations and detailed fabrication and assembly of pipe anchors and alignment guides, hangers and supports for multiple pipes, expansion joints and loops, and attachments of the same to the building structure.
   2. Locations of pipe anchors and alignment guides and expansion joints and loops.
   3. Locations of and details for penetrations, including sleeves and sleeve seals for exterior walls, floors, basement, and foundation walls.

1.05 INFORMATIONAL SUBMITTALS

A. System purging and disinfecting activities report.
B. Field quality-control reports.

PART 2 PRODUCTS

2.01 PIPING MATERIALS

A. Comply with requirements in "Piping Schedule" Article for applications of pipe, tube, fitting materials, and joining methods for specific services, service locations, and pipe sizes.
B. Potable-water piping and components shall comply with NSF 14 and NSF 61. Plastic piping components shall be marked with "NSF-pw."
C. All piping shall be American made and tested; no import pipe will be permitted.
D. All exposed water supply piping in toilet rooms, custodial rooms and kitchens shall be chromium plated.
E. All piping installed in or passing through a plenum must be plenum rated, fire wrapped, or installed in a metal conduit.

2.02 COPPER TUBE AND FITTINGS

A. Hard Copper Tube: ASTM B 88, Type K and ASTM B 88, Type L water tube, drawn temper.
B. Soft Copper Tube: ASTM B 88, Type K and ASTM B 88, Type L water tube, annealed temper.
C. Cast-Copper, Solder-Joint Fittings: ASME B16.18, pressure fittings.
D. Wrought-Copper, Solder-Joint Fittings: ASME B16.22, wrought-copper pressure fittings.
E. Bronze Flanges: ASME B16.24, Class 150, with solder-joint ends.
F. Copper Unions:
    1. MSS SP-123.
    2. Cast-copper-alloy, hexagonal-stock body.
    3. Ball-and-socket, metal-to-metal seating surfaces.
    4. Solder-joint or threaded ends.

2.03 PIPING JOINING MATERIALS

A. Pipe-Flange Gasket Materials:
    1. AWWA C110/A21.10, rubber, flat face, 1/8 inch thick or ASME B16.21, nonmetallic and asbestos free unless otherwise indicated.
    2. Full-face or ring type unless otherwise indicated.
B. Metal, Pipe-Flange Bolts and Nuts: ASME B18.2.1, carbon steel unless otherwise indicated.
C. Solder Filler Metals: ASTM B 32, lead-free alloys.
D. Flux: ASTM B 813, water flushable.
E. Brazing Filler Metals: AWS A5.8/A5.8M, BCuP Series, copper-phosphorus alloys for general-duty brazing unless otherwise indicated.

2.04 TRANSITION FITTINGS

A. General Requirements:
    1. Same size as pipes to be joined.
    2. Pressure rating at least equal to pipes to be joined.

3. End connections compatible with pipes to be joined.

B. Fitting-Type Transition Couplings: Manufactured piping coupling or specified piping system fitting.

C. Sleeve-Type Transition Coupling: AWWA C219.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. Cascade Waterworks Manufacturing.
   b. Dresser, Inc.; Piping Specialties Products.
   c. Ford Meter Box Company, Inc. (The).
   d. JCM Industries.
   e. Romac Industries, Inc.
   f. Smith-Blair, Inc.; a Sensus company.
   g. Viking Johnson.

2.05 DIELECTRIC FITTINGS

A. General Requirements: Assembly of copper alloy and ferrous materials with separating nonconductive insulating material. Include end connections compatible with pipes to be joined.

B. Dielectric Nipples and Waterways:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. Elster Perfection Corporation.
   b. Grinnell Mechanical Products; Tyco Fire Products LP.
   c. Matco-Norca.
   d. Clearflow/Perfection Corp.
   e. Precision Plumbing Products, Inc.
   f. Victaulic Company.
2. Standard: IAPMO PS 66 or ASTM F-1545-97.
3. Electroplated steel nipple or waterway complying with ASTM F 1545 or ANSI/NSF-61 Compliant.
4. Pressure Rating and Temperature: 300 psig at 225 deg F.
5. End Connections: Male threaded or grooved.
6. Lining: Inert and noncorrosive, propylene or LTHS.

PART 3 EXECUTION

3.01 PIPING INSTALLATION

A. Drawing plans, schematics, and diagrams indicate general location and arrangement of domestic water piping. Indicated locations and arrangements are used to size pipe and calculate friction loss, expansion, and other design considerations. Install piping as indicated unless deviations to layout are approved on coordination drawings.

B. Install shutoff valve, hose-end drain valve, strainer, pressure gage, and test tee with valve inside the building at each domestic water-service entrance. Comply with requirements for pressure gages in Division 22 Section "Meters and Gages for Plumbing Piping" and with requirements for drain valves and strainers in Division 22 Section "Domestic Water Piping Specialties."
C. Install shutoff valve immediately upstream of each dielectric fitting.
D. Install seismic restraints on piping. Comply with SEI/ASCE 7 and with requirements for seismic-restraint devices in Division 22 Section "Vibration and Seismic Controls for Plumbing Piping and Equipment."
E. Install piping concealed from view and protected from physical contact by building occupants unless otherwise indicated and except in equipment rooms and service areas.
F. Install piping indicated to be exposed and piping in equipment rooms and service areas at right angles or parallel to building walls. Diagonal runs are prohibited unless specifically indicated otherwise.
G. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal, and coordinate with other services occupying that space.
H. Install piping to permit valve servicing.
I. Install nipples, unions, special fittings, and valves with pressure ratings the same as or higher than the system pressure rating used in applications below unless otherwise indicated.
J. Install piping free of sags and bends.
K. Install fittings for changes in direction and branch connections.
L. Install unions in copper tubing at final connection to each piece of equipment, machine, and specialty.
M. Install sleeves for piping penetrations of walls, ceilings, and floors. Comply with requirements for sleeves specified in Division 22 Section "Sleeves and Sleeve Seals for Plumbing Piping."
N. Install sleeve seals for piping penetrations of concrete walls and slabs. Comply with requirements for sleeve seals specified in Division 22 Section "Sleeves and Sleeve Seals for Plumbing Piping."
O. Install escutcheons for piping penetrations of walls, ceilings, and floors. Comply with requirements for escutcheons specified in Division 22 Section "Escutcheons for Plumbing Piping."

3.02 JOINT CONSTRUCTION

A. Ream ends of pipes and tubes and remove burrs. Bevel plain ends of steel pipe.
B. Remove scale, slag, dirt, and debris from inside and outside of pipes, tubes, and fittings before assembly.
C. Threaded Joints: Thread pipe with tapered pipe threads according to ASME B1.20.1. Cut threads full and clean using sharp dies. Ream threaded pipe ends to remove burrs and restore full ID. Join pipe fittings and valves as follows:
    1. Apply appropriate tape or thread compound to external pipe threads.
    2. Damaged Threads: Do not use pipe or pipe fittings with threads that are corroded or damaged.

D. Brazed Joints for Copper Tubing: Comply with CDA's "Copper Tube Handbook," "Brazed Joints" chapter.
E. Soldered Joints for Copper Tubing: Apply ASTM B 813, water-flushable flux to end of tube. Join copper tube and fittings according to ASTM B 828 or CDA's "Copper Tube Handbook."
F. Flanged Joints: Select appropriate asbestos-free, nonmetallic gasket material in size, type, and thickness suitable for domestic water service. Join flanges with gasket and bolts according to ASME B31.9.
G. Joints for Dissimilar-Material Piping: Make joints using adapters compatible with materials of both piping systems.

3.03 TRANSITION FITTING INSTALLATION

A. Install transition couplings at joints of dissimilar piping.
B. Transition Fittings in Underground Domestic Water Piping:
   1. Fittings for NPS 1-1/2 and Smaller: Fitting-type coupling.
   2. Fittings for NPS 2 and Larger: Sleeve-type coupling.

3.04 DIELECTRIC FITTING INSTALLATION

A. Install dielectric fittings in piping at connections of dissimilar metal piping and tubing.
B. Dielectric Fittings for NPS 2 and Smaller: Use dielectric nipples/waterways.
C. Dielectric Fittings for NPS 2-1/2 to NPS 4: Use dielectric nipples/waterways.
D. Dielectric Fittings for NPS 5 and Larger: Use dielectric nipples/waterways.

3.05 HANGER AND SUPPORT INSTALLATION

A. Comply with requirements for seismic-restraint devices in Division 22 Section "Vibration and Seismic Controls for Plumbing Piping and Equipment."
B. Comply with requirements for pipe hanger, support products, and installation in Division 22 Section "Hangers and Supports for Plumbing Piping and Equipment."
   1. Vertical Piping: MSS Type 8 or 42, clamps.
   2. Individual, Straight, Horizontal Piping Runs:
      a. 100 Feet and Less: MSS Type 1, adjustable, steel clevis hangers.
      b. Longer Than 100 Feet: MSS Type 43, adjustable roller hangers.
      c. Longer Than 100 Feet if Indicated: MSS Type 49, spring cushion rolls.
   3. Multiple, Straight, Horizontal Piping Runs 100 Feet or Longer: MSS Type 44, pipe rolls. Support pipe rolls on trapeze.
   4. Base of Vertical Piping: MSS Type 52, spring hangers.
C. Support vertical piping and tubing at base and at each floor.
D. Rod diameter may be reduced one size for double-rod hangers, to a minimum of 3/8 inch.
E. Install hangers for copper tubing with the following maximum horizontal spacing and minimum rod diameters:
   1. NPS 3/4 and Smaller: 60 inches with 3/8-inch rod.
   2. NPS 1 and NPS 1-1/4: 72 inches with 3/8-inch rod.

3. NPS 1-1/2 and NPS 2: 96 inches with 3/8-inch rod.
4. NPS 2-1/2: 108 inches with 1/2-inch rod.
5. NPS 3 to NPS 5: 10 feet with 1/2-inch rod.
6. NPS 6: 10 feet with 5/8-inch rod.
7. NPS 8: 10 feet with 3/4-inch rod.

F. Install supports for vertical copper tubing every 10 feet.

G. Support piping and tubing not listed in this article according to MSS SP-69 and manufacturer's written instructions.

3.06 CONNECTIONS

A. Drawings indicate general arrangement of piping, fittings, and specialties.

B. When installing piping adjacent to equipment and machines, allow space for service and maintenance.

C. Connect domestic water piping to exterior water-service piping. Use transition fitting to join dissimilar piping materials.

D. Connect domestic water piping to water-service piping with shutoff valve; extend and connect to the following:

1. Water Heaters: Cold-water inlet and hot-water outlet piping in sizes indicated, but not smaller than sizes of water heater connections.
2. Plumbing Fixtures: Cold- and hot-water-supply piping in sizes indicated, but not smaller than that required by plumbing code. Comply with requirements for connection sizes in Division 22 plumbing fixture Sections.
3. Equipment: Cold- and hot-water-supply piping as indicated, but not smaller than equipment connections. Provide shutoff valve and union for each connection. Use flanges instead of unions for NPS 2-1/2 and larger.

3.07 IDENTIFICATION

A. Identify system components. Comply with requirements for identification materials and installation in Division 22 Section "Identification for Plumbing Piping and Equipment."

B. Label pressure piping with system operating pressure.

3.08 FIELD QUALITY CONTROL

A. Perform the following tests and inspections:

1. Piping Inspections:
   a. Do not enclose, cover, or put piping into operation until it has been inspected and approved by authorities having jurisdiction.
   b. During installation, notify authorities having jurisdiction at least one day before inspection must be made. Perform tests specified below in presence of authorities having jurisdiction:
      1) Roughing-in Inspection: Arrange for inspection of piping before concealing or closing in after roughing in and before setting fixtures.

2) Final Inspection: Arrange for authorities having jurisdiction to observe tests specified in "Piping Tests" Subparagraph below and to ensure compliance with requirements.

c. Reinspection: If authorities having jurisdiction find that piping will not pass tests or inspections, make required corrections and arrange for reinspection.

d. Reports: Prepare inspection reports and have them signed by authorities having jurisdiction.

2. Piping Tests:

a. Fill domestic water piping. Check components to determine that they are not air bound and that piping is full of water.

b. Test for leaks and defects in new piping and parts of existing piping that have been altered, extended, or repaired. If testing is performed in segments, submit a separate report for each test, complete with diagram of portion of piping tested.

c. Leave new, altered, extended, or replaced domestic water piping uncovered and unconcealed until it has been tested and approved. Expose work that was covered or concealed before it was tested.

d. Cap and subject piping to static water pressure of 50 psig above operating pressure, without exceeding pressure rating of piping system materials. Isolate test source and allow it to stand for four hours. Leaks and loss in test pressure constitute defects that must be repaired.

e. Repair leaks and defects with new materials, and retest piping or portion thereof until satisfactory results are obtained.

f. Prepare reports for tests and for corrective action required.

B. Domestic water piping will be considered defective if it does not pass tests and inspections.

C. Prepare test and inspection reports.

3.09 ADJUSTING

A. Perform the following adjustments before operation:

1. Close drain valves, hydrants, and hose bibbs.
2. Open shutoff valves to fully open position.
3. Open throttling valves to proper setting.
4. Adjust balancing valves in hot-water-circulation return piping to provide adequate flow.
   a. Manually adjust ball-type balancing valves in hot-water-circulation return piping to provide hot-water flow in each branch.
   b. Adjust calibrated balancing valves to flows indicated.
5. Remove plugs used during testing of piping and for temporary sealing of piping during installation.
6. Remove and clean strainer screens. Close drain valves and replace drain plugs.
7. Remove filter cartridges from housings and verify that cartridges are as specified for application where used and are clean and ready for use.
8. Check plumbing specialties and verify proper settings, adjustments, and operation.

3.10 CLEANING

A. Clean and disinfect potable domestic water piping as follows:
   1. Purge new piping and parts of existing piping that have been altered, extended, or repaired before using.
   2. Use purging and disinfecting procedures prescribed by authorities having jurisdiction; if methods are not prescribed, use procedures described in either AWWA C651 or AWWA C652 or follow procedures described below:
      a. Flush piping system with clean, potable water until dirty water does not appear at outlets.
      b. Fill and isolate system according to either of the following:
         1) Fill system or part thereof with water/chlorine solution with at least 50 ppm of chlorine. Isolate with valves and allow to stand for 24 hours.
         2) Fill system or part thereof with water/chlorine solution with at least 200 ppm of chlorine. Isolate and allow to stand for three hours.
      c. Flush system with clean, potable water until no chlorine is in water coming from system after the standing time.
      d. Repeat procedures if biological examination shows contamination.
      e. Submit water samples in sterile bottles to authorities having jurisdiction.

B. Clean non-potable domestic water piping as follows:
   1. Purge new piping and parts of existing piping that have been altered, extended, or repaired before using.
   2. Use purging procedures prescribed by authorities having jurisdiction or; if methods are not prescribed, follow procedures described below:
      a. Flush piping system with clean, potable water until dirty water does not appear at outlets.
      b. Submit water samples in sterile bottles to authorities having jurisdiction. Repeat procedures if biological examination shows contamination.

C. Prepare and submit reports of purging and disinfecting activities. Include copies of water-sample approvals from authorities having jurisdiction.

D. Clean interior of domestic water piping system. Remove dirt and debris as work progresses.

3.11 PIPING SCHEDULE

A. Some piping types and sizes mentioned in this section may not be used on this project.

B. Transition and special fittings with pressure ratings at least equal to piping rating may be used in applications below unless otherwise indicated.

C. Flanges and unions may be used for aboveground piping joints unless otherwise indicated.

D. All exposed water supply piping in toilet rooms, custodial rooms and kitchens shall be chromium plated.

E. Under-building-slab, domestic water, building-service piping, NPS 3and smaller, shall be the following:
   1. Soft copper tube, ASTM B 88, Type K; wrought-copper, brazed joints and fittings.

F. Aboveground domestic water piping, NPS 2and smaller, shall be the following:

1. Hard copper tube, ASTM B 88, Type L; cast- copper, solder-joint fittings; and soldered joints.

G. Aboveground domestic water piping, NPS 2-1/2 to NPS 4, shall be the following:
   1. Hard copper tube, ASTM B 88, Type L; cast- copper, solder-joint fittings; and soldered joints.

3.12 VALVE SCHEDULE

A. Drawings indicate valve types to be used. Where specific valve types are not indicated, the following requirements apply:
   1. Shutoff Duty: Use ball for piping NPS 3 and smaller. Use butterfly or ball, with flanged ends for piping NPS 4 and larger.
   2. Throttling Duty: Use ball valves for piping NPS 2 and smaller. Use butterfly or ball valves with flanged ends for piping NPS 2-1/2 and larger.
   3. Hot-Water Circulation Piping, Balancing Duty: Calibrated balancing valves.
   4. Drain Duty: Hose-end drain valves.
B. Use check valves to maintain correct direction of domestic water flow to and from equipment.

END OF SECTION 22 1116

SECTION 22 1119 - DOMESTIC WATER PIPING SPECIALTIES

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Furnish all labor, materials, equipment, tools and services required to fully complete all. Domestic Water Pipe work as is indicated on the drawings and/or specified herein including, but not limited to, the following described items.

1. The following domestic water piping specialties:
   a. Vacuum breakers.
   b. Backflow preventers.
   c. Strainers.
   d. Hose bibbs.
   e. Wall hydrants.
   f. Circulation Pumps
   g. Water hammer arresters.

1.02 RELATED REQUIREMENTS

A. Division 22 Section "Meters and Gages for Plumbing Piping" for thermometers, pressure gages, and flow meters in domestic water piping.

B. Division 22 Section "Emergency Plumbing Fixtures" for water tempering equipment.

C. Division 22 Section "Pressure Water Coolers" for water filters for water coolers.

1.03 PERFORMANCE REQUIREMENTS

A. Minimum Working Pressure for Domestic Water Piping Specialties: 125 psig, unless otherwise indicated.

1.04 SUBMITTALS

A. Product Data: For each type of product indicated.

B. Shop Drawings: Diagram power, signal, and control wiring.

C. Field quality-control test reports.

D. Operation and Maintenance Data: For domestic water piping specialties to include in emergency, operation, and maintenance manuals.

1.05 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. NSF Compliance:

1. Comply with NSF 14, "Plastics Piping Components and Related Materials," for plastic domestic water piping components.
2. Comply with NSF 61, "Drinking Water System Components - Health Effects; Sections 1 through 9."

PART 2 PRODUCTS

2.01 VACUUM BREAKERS

A. Spill-Resistant Vacuum Breakers:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. Conbraco Industries, Inc.
   b. Watts Industries, Inc.; Water Products Div.
2. Standard: ASSE 1056.
3. Operation: Continuous-pressure applications.
4. Accessories:
   a. Valves: Ball type, on inlet and outlet.

2.02 BACKFLOW PREVENTERS

A. Reduced-Pressure-Principle Backflow Preventers:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. Ames Co.
   b. Conbraco Industries, Inc.
   c. FEBCO; SPX Valves & Controls.
   d. Flomatic Corporation.
   e. Watts Industries, Inc.; Water Products Div.
   f. Zurn Plumbing Products Group; Wilkins Div.
2. Standard: ASSE 1013.
3. Operation: Continuous-pressure applications.
4. Pressure Loss: 12 psig maximum, through middle 1/3 of flow range.
5. Body: Bronze for NPS 2 and smaller; cast iron with interior lining complying with AWWA C550 or that is FDA approved] for NPS 2-1/2 and larger.
6. End Connections: Threaded for NPS 2 and smaller; flanged for NPS 2-1/2 and larger.

7. Accessories:
   a. Valves: Ball type with threaded ends on inlet and outlet ofNPS 2 and smaller; outside screw and yoke gate-type with flanged ends on inlet and outlet of NPS 2-1/2 and larger.
   b. Air-Gap Fitting: ASME A112.1.2, matching backflow-preventer connection.

2.03 HOSE BIBBS

A. Hose Bibbs:

1. Chrome plated brass, removable key, vacuum breaker, ¾" inlet and outlet, provide isolation valve upstream of bibb.
2. Manufacturers:
   a. Chicago Model 998-RCF
   b. T&S Brass

2.04 NON-FREEZE WALL HYDRANT:

A. Wall Hydrant:

1. Bronze Hydrant, exposed type removable key, vacuum breaker, automatic draining, stainless steel operating system, rough brass finish.
2. Manufacturers:
   a. Woodford No. 65
   b. Zurn
   c. Sloan

2.05 WATER HAMMER ARRESTERS

A. Water Hammer Arresters:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. AMTROL, Inc.
   b. Josam Company.
   c. MIFAB, Inc.
   d. PPP Inc.
   e. Sioux Chief Manufacturing Company, Inc.
   f. Smith, Jay R. Mfg. Co.; Division of Smith Industries, Inc.
   g. Tyler Pipe; Wade Div.
   h. Watts Drainage Products Inc.
   i. Zurn Plumbing Products Group; Specification Drainage Operation.
2. Standard: ASSE 1010 or PDI-WH 201.
3. Type: Metal bellows or Copper tube with piston. Maintenance free no access required.
4. Size: ASSE 1010, Sizes AA and A through F or PDI-WH 201, Sizes A through F.

2.06 DOMESTIC CIRCULATING PUMP

A. General: Provide factory-tested pumps, thoroughly cleaned, and painted with one coat of machinery enamel prior to shipment. Type, size, and capacity of each pump is listed in pump schedule. Provide pumps of same type by same manufacturer.

B. Product:

1. Type Horizontal, oil-lubricated, designed for 125 psi working pressure, 225°F (107°C) continuous water temperature, and specifically designed for quiet operation.
2. Body: Bronze or stainless steel construction.
3. Impeller: Bronze
4. Shaft: Steel, ground and polished, integral thrust collar.
5. Bearings: Two horizontal sleeve bearings designed to circulate oil.
6. Seal: Mechanical, with carbon seal face rotating against ceramic seat.
7. Motor: Non-overloading at any point on pump curve, open, drip-proof, sleeve bearings, quiet operating, rubber mounted construction, built-in thermal overload protection.
8. Coupling: Self-aligning, flexible coupling.
9. Manufacturer: Subject to compliance with requirements, provide in-line recirculation pumps of one of the following:
   a. Grundfos
   b. Bell and Gossett
   c. Taco

PART 3 EXECUTION

3.01 INSTALLATION

A. Refer to Division 22 Section "Common Work Results for Plumbing" for piping joining materials, joint construction, and basic installation requirements.

B. Install backflow preventers in each water supply to mechanical equipment and systems and to other equipment and water systems that may be sources of contamination. Comply with authorities having jurisdiction.

1. Locate backflow preventers in same room as connected equipment or system.
2. Install drain for backflow preventers with atmospheric-vent drain connection with air-gap fitting, fixed air-gap fitting, or equivalent positive pipe separation of at least two pipe diameters in drain piping and pipe to floor drain. Locate air-gap device attached to or under backflow preventer. Simple air breaks are not acceptable for this application.
3. Do not install bypass piping around backflow preventers.

C. Install water control valves with inlet and outlet shutoff valves. Install pressure gages on inlet and outlet.

D. Install water hammer arresters in water piping according to PDI-WH 201.

3.02 CONNECTIONS

A. Piping installation requirements are specified in other Division 22 Sections. Drawings indicate general arrangement of piping and specialties.

B. Ground equipment according to Division 26 Section "Grounding and Bonding for Electrical Systems."

C. Connect wiring according to Division 26 Section "Low-Voltage Electrical Power Conductors and Cables."

3.03 LABELING AND IDENTIFYING

A. Equipment Nameplates and Signs: Install engraved plastic-laminate equipment nameplate or sign on or near each of the following:

1. Pressure vacuum breakers.
2. Reduced-pressure-principle backflow preventers.
3. Double-check backflow-prevention assemblies.
4. Carbonated-beverage-machine backflow preventers.
5. Dual-check-valve backflow preventers.
6. Water pressure-reducing valves.
7. Calibrated balancing valves.
8. Primary water tempering valves.
9. Outlet boxes.
10. Supply-type, trap-seal primer valves.

B. Distinguish among multiple units, inform operator of operational requirements, indicate safety and emergency precautions, and warn of hazards and improper operations, in addition to identifying unit. Nameplates and signs are specified in Division 22 Section "Identification for Plumbing Piping and Equipment."

3.04 FIELD QUALITY CONTROL

A. Perform the following tests and prepare test reports:

1. Test each backflow preventer according to authorities having jurisdiction and the device's reference standard.

B. Remove and replace malfunctioning domestic water piping specialties and retest as specified above.

3.05 ADJUSTING

A. Set field-adjustable pressure set points of water pressure-reducing valves.

B. Set field-adjustable flow set points of balancing valves.

C. Set field-adjustable temperature set points of temperature-actuated water mixing valves.

END OF SECTION 22 1119

SECTION 22 1316 - SANITARY WASTE AND VENT PIPING

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Furnish all labor, materials, equipment, tools and services required to fully complete all Sanitary Waste Pipe work as is indicated on the drawings and/or specified herein including, but not limited to, the following described items.
   1. Pipe, tube, and fittings.
   2. Specialty pipe fittings.

1.02 DEFINITIONS

A. EPDM: Ethylene-propylene-diene terpolymer rubber.
B. PVC: Polyvinyl chloride plastic.

1.03 PERFORMANCE REQUIREMENTS

A. Components and installation shall be capable of withstanding the following minimum working pressure unless otherwise indicated:
   1. Soil, Waste, and Vent Piping: 10-foot head of water.
B. Seismic Performance: Soil, waste, and vent piping and support and installation shall withstand the effects of earthquake motions determined according to SEI/ASCE 7 and with the requirements specified in Section 230548 "Vibration and Seismic Controls for HVAC."
   1. For piping with a seismic importance factor of 1.0 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. For piping with a seismic importance factor of 1.5 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."

1.04 ACTION SUBMITTALS

A. Product Data: For each type of product indicated.

1.05 INFORMATIONAL SUBMITTALS

A. Seismic Qualification Certificates: For waste and vent piping, accessories, and components, from manufacturer.
   1. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.
   2. Detailed description of piping anchorage devices on which the certification is based and their installation requirements.
B. Field quality-control reports.

1.06 QUALITY ASSURANCE

A. Piping materials shall bear label, stamp, or other markings of specified testing agency.
B. Comply with NSF/ANSI 14, "Plastics Piping Systems Components and Related Materials," for plastic piping components. Include marking with "NSF-dwv" for plastic drain, waste, and vent piping; "NSF-sewer" for plastic sewer piping; "NSF-drain" for plastic drain piping, and "NSF-tubular" for plastic continuous waste piping.

1.07 PROJECT CONDITIONS

A. Interruption of Existing Sanitary Waste Service: Do not interrupt service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary service according to requirements indicated:
   1. Notify Construction Manager no fewer than two days in advance of proposed interruption of sanitary waste service.

PART 2 PRODUCTS

2.01 PIPING MATERIALS

A. Comply with requirements in "Piping Schedule" Article for applications of pipe, tube, fitting materials, and joining methods for specific services, service locations, and pipe sizes.

2.02 HUBLESS, CAST-IRON SOIL PIPE AND FITTINGS

A. Pipe and Fittings: All cast-iron waste, vent and sewer pipe and fittings shall conform to the requirements of CISPI Standard 301 and ASTM A888. All products shall be marked with the collective trademark of the Cast Soil Pipe Institute and shall be listed by NSF International or receive prior approval of the engineer. All cast-iron pipe and fittings shall be American made and tested. Non-compliant import cast-iron products will not be permitted. Any non-compliant cast-iron product installed by the contractor on this project will be replaced at the contractor’s expense and shall include all repairs, patching, painting and other incidental work required to return the project to its pre-remediation state.
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      a. AB&I Foundry
      b. Charoltte Pipe
      c. Tyler Pipe
B. CISPI, Hubless-Piping Couplings:
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      a. ANACO.
      b. Ideal
      c. Mission Rubber Company; a division of MCP Industries, Inc.
      d. Tyler Pipe.

2. Standards: ASTM C1277 and CISPI 310.
3. Description: Stainless-steel corrugated shield with stainless-steel bands and tightening devices; and ASTM C 564, rubber sleeve with integral, center pipe stop.
4. Listing: Couplings shall be listed by NSF International. Each coupling shall be embossed with the NSF seal.

C. Heavy-Duty, Hubless-Piping Couplings:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
a. Husky SD 4000.
b. Clamp-All Corp HI-TORQ 125.
c. Ideal HD
d. Mission HW.
e. Tyler Pipe Widebody.
2. Standards: ASTM C 1277 and ASTM C 1540.
3. Description: Stainless-steel shield with stainless-steel bands and tightening devices; and ASTM C 564, rubber sleeve with integral, center pipe stop.

2.03 PVC PIPE AND FITTINGS

A. Solid-Wall PVC Pipe: ASTM D2665, drain, waste, and vent.
B. PVC Socket Fittings: ASTM D2665, made to ASTM D 3311, drain, waste, and vent patterns and to fit Schedule 40 pipe.
C. Adhesive Primer: ASTM F656.
1. Adhesive primer shall have a VOC content of 550 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
D. Solvent Cement: ASTM D2564.
1. PVC solvent cement shall have a VOC content of 510 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

PART 3 EXECUTION

3.01 EARTH MOVING

A. Comply with requirements for excavating, trenching, and backfilling specified in Division 31 Section "Earth Moving."

3.02 PIPING INSTALLATION

A. Drawing plans, schematics, and diagrams indicate general location and arrangement of piping systems. Indicated locations and arrangements were used to size pipe and calculate friction loss, expansion, pump sizing, and other design considerations. Install piping as indicated unless deviations to layout are approved on coordination drawings.
B. Install piping in concealed locations unless otherwise indicated and except in equipment rooms and service areas.

C. Install piping indicated to be exposed and piping in equipment rooms and service areas at right angles or parallel to building walls. Diagonal runs are prohibited unless specifically indicated otherwise.
D. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal.
E. Install piping at indicated slopes.
F. Install piping free of sags and bends.
G. Install fittings for changes in direction and branch connections.
H. Install piping to allow application of insulation.
I. Install seismic restraints on piping. Comply with SEI/ASCE 7 and with requirements for seismic-restraint devices specified in Division 22 Section "Vibration and Seismic Controls for Plumbing Piping and Equipment."
J. Make changes in direction for soil and waste drainage and vent piping using appropriate branches, bends, and long-sweep bends. Sanitary tees and short-sweep 1/4 bends may be used on vertical stacks if change in direction of flow is from horizontal to vertical. Use long-turn, double Y-branch and 1/8-bend fittings if two fixtures are installed back to back or side by side with common drain pipe. Straight tees, elbows, and crosses may be used on vent lines. Do not change direction of flow more than 90 degrees. Use proper size of standard increasers and reducers if pipes of different sizes are connected. Reducing size of drainage piping in direction of flow is prohibited.
K. Lay buried building drainage piping beginning at low point of each system. Install true to grades and alignment indicated, with unbroken continuity of invert.
L. Install soil and waste drainage and vent piping at the following minimum slopes unless otherwise indicated:
    1. Building Sanitary Drain: 2 percent downward in direction of flow for piping.
    2. Horizontal Sanitary Drainage Piping: 2 percent downward in direction of flow.
    3. Vent Piping: 1 percent down toward vertical fixture vent or toward vent stack.
M. Install cast-iron soil piping according to CISPI's "Cast Iron Soil Pipe and Fittings Handbook," Chapter IV, "Installation of Cast Iron Soil Pipe and Fittings."
    1. Install encasement on underground piping according to ASTM A 674 or AWWA C105/A 21.5.
N. Install underground PVC piping according to ASTM D2321.
O. Install engineered soil and waste drainage and vent piping systems as follows:
    1. Combination Waste and Vent: Comply with standards of authorities having jurisdiction.
P. Plumbing Specialties:
    1. Install cleanouts at grade and extend to where building sanitary drains connect to building sanitary sewers in sanitary drainage gravity-flow piping. Install cleanout fitting with closure plug inside the building in sanitary drainage force-main piping. Comply with requirements for cleanouts specified in Division 22 Section "Sanitary Waste Piping Specialties."
    2. Install drains in sanitary drainage gravity-flow piping. Comply with requirements for drains specified in Division 22 Section "Sanitary Waste Piping Specialties."
    3. Install cleanout fitting with closure plug inside the building in sanitary force-main piping.

Q. Do not enclose, cover, or put piping into operation until it is inspected and approved by authorities having jurisdiction.
R. Install sleeves for piping penetrations of walls, ceilings, and floors. Comply with requirements for sleeves specified in Division 22 Section "Sleeves and Sleeve Seals for Plumbing Piping."
S. Install sleeve seals for piping penetrations of concrete walls and slabs. Comply with requirements for sleeve seals specified in Division 22 Section "Sleeves and Sleeve Seals for Plumbing Piping."
T. Install escutcheons for piping penetrations of walls, ceilings, and floors. Comply with requirements for escutcheons specified in Division 22 Section "Escutcheons for Plumbing Piping."

3.03 JOINT CONSTRUCTION

A. Join hubless, cast-iron soil piping according to CISPI 310 and CISPI's "Cast Iron Soil Pipe and Fittings Handbook" for hubless-piping coupling joints.
B. Plastic, Nonpressure-Piping, Solvent-Cement Joints: Clean and dry joining surfaces. Join pipe and fittings according to the following:
    1. Comply with ASTM F402 for safe-handling practice of cleaners, primers, and solvent cements.
    2. PVC Piping: Join according to ASTM D2855 and ASTM D2665 Appendixes.

3.04 HANGER AND SUPPORT INSTALLATION

A. Comply with requirements for seismic-restraint devices specified in Division 22 Section "Vibration and Seismic Controls for Plumbing Piping and Equipment."
B. Comply with requirements for pipe hanger and support devices and installation specified in Division 22 Section "Hangers and Supports for Plumbing Piping and Equipment."
    1. Install carbon-steel pipe hangers for horizontal piping in noncorrosive environments.
    2. Install stainless-steel pipe hangers for horizontal piping in corrosive environments.
    3. Install carbon-steel pipe support clamps for vertical piping in noncorrosive environments.
    4. Install stainless-steel pipe support clamps for vertical piping in corrosive environments.
    5. Vertical Piping: MSS Type 8 or Type 42, clamps.
    6. Install individual, straight, horizontal piping runs:
        a. 100 Feet and Less: MSS Type 1, adjustable, steel clevis hangers.
        b. Longer Than 100 Feet: MSS Type 43, adjustable roller hangers.
        c. Longer Than 100 Feet if Indicated: MSS Type 49, spring cushion rolls.
    7. Multiple, Straight, Horizontal Piping Runs 100 Feet or Longer: MSS Type 44, pipe rolls. Support pipe rolls on trapeze.
    8. Base of Vertical Piping: MSS Type 52, spring hangers.
C. Support horizontal piping and tubing within 12 inches of each fitting and coupling or valve and coupling.
D. Support vertical piping and tubing at base and at each floor.
E. Rod diameter may be reduced one size for double-rod hangers, with 3/8-inch minimum rods.

F. Install hangers for cast-iron soil piping with the following maximum horizontal spacing and minimum rod diameters:
   1. NPS 1-1/2 and NPS 2: 60 inches with 3/8-inch rod.
   2. NPS 3: 60 inches with 1/2-inch rod.
   3. NPS 4 and NPS 5: 60 inches with 5/8-inchod.
   4. NPS 6 and NPS 8: 60 inches with 3/4-inch rod.
   5. NPS 10 and NPS 12: 60 inches with 7/8-inch rod.
   6. Spacing for 10-foot lengths may be increased to 10 feet. Spacing for fittings is limited to 60 inches.

G. Install supports for vertical cast-iron soil piping every 15 feet.

H. Install hangers for PVC piping with the following maximum horizontal spacing and minimum rod diameters:
   1. NPS 1-1/2 and NPS: 48 inches with 3/8-inchrod.
   2. NPS 3: 48 inches with 1/2-inchrod.
   3. NPS 4 and NPS 5: 48 inches with 5/8-inchrod.
   4. NPS 6 and NPS 8: 48 inches with 3/4-inchrod.
   5. NPS 10 and NPS 12: 48 inches with 7/8-inchrod.

I. Install supports for vertical PVC piping every 48 inches.

J. Support piping and tubing not listed above according to MSS SP-69 and manufacturer's written instructions.

3.05 CONNECTIONS

A. Drawings indicate general arrangement of piping, fittings, and specialties.

B. Connect soil and waste piping to exterior sanitary sewerage piping. Use transition fitting to join dissimilar piping materials.

C. Connect drainage and vent piping to the following:
   1. Plumbing Fixtures: Connect drainage piping in sizes indicated, but not smaller than required by plumbing code.
   2. Plumbing Fixtures and Equipment: Connect atmospheric vent piping in sizes indicated, but not smaller than required by authorities having jurisdiction.
   3. Plumbing Specialties: Connect drainage and vent piping in sizes indicated, but not smaller than required by plumbing code.
   4. Install test tees (wall cleanouts) in conductors near floor and floor cleanouts with cover flush with floor.
   5. Comply with requirements for cleanouts and drains specified in Division 22 Section "Sanitary Waste Piping Specialties."
   6. Equipment: Connect drainage piping as indicated. Provide shutoff valve if indicated and union for each connection. Use flanges instead of unions for connections NPS 2-1/2 and larger.

D. Where installing piping adjacent to equipment, allow space for service and maintenance of equipment.

E. Make fixture and equipment connections according to the following unless otherwise indicated:

1. Install unions, in piping NPS 2 and smaller, adjacent to each valve and at final connection to each piece of equipment.
2. Install flanges, in piping NPS 2-1/2 and larger, adjacent to flanged valves and at final connection to each piece of equipment.

3.06 IDENTIFICATION

A. Identify exposed sanitary waste and vent piping. Comply with requirements for identification specified in Division 22 Section "Identification for Plumbing Piping and Equipment."

3.07 FIELD QUALITY CONTROL

A. During installation, notify authorities having jurisdiction at least 24 hours before inspection must be made. Perform tests specified below in presence of authorities having jurisdiction.
   1. Roughing-in Inspection: Arrange for inspection of piping before concealing or closing-in after roughing-in and before setting fixtures.
   2. Final Inspection: Arrange for final inspection by authorities having jurisdiction to observe tests specified below and to ensure compliance with requirements.
B. Reinspection: If authorities having jurisdiction find that piping will not pass test or inspection, make required corrections and arrange for reinspection.
C. Reports: Prepare inspection reports and have them signed by authorities having jurisdiction.
D. Test sanitary drainage and vent piping according to procedures of authorities having jurisdiction or, in absence of published procedures, as follows:
   1. Test for leaks and defects in new piping and parts of existing piping that have been altered, extended, or repaired. If testing is performed in segments, submit separate report for each test, complete with diagram of portion of piping tested.
   2. Leave uncovered and unconcealed new, altered, extended, or replaced drainage and vent piping until it has been tested and approved. Expose work that was covered or concealed before it was tested.
   3. Roughing-in Plumbing Test Procedure: Test drainage and vent piping except outside leaders on completion of roughing-in. Close openings in piping system and fill with water to point of overflow, but not less than 10-foot head of water. From 15 minutes before inspection starts to completion of inspection, water level must not drop. Inspect joints for leaks.
   4. Finished Plumbing Test Procedure: After plumbing fixtures have been set and traps filled with water, test connections and prove they are gastight and watertight. Plug vent-stack openings on roof and building drains where they leave building. Introduce air into piping system equal to pressure of 1-inch wg. Use U-tube or manometer inserted in trap of water closet to measure this pressure. Air pressure must remain constant without introducing additional air throughout period of inspection. Inspect plumbing fixture connections for gas and water leaks.
   5. Repair leaks and defects with new materials and retest piping, or portion thereof, until satisfactory results are obtained.
   6. Prepare reports for tests and required corrective action.

3.08 CLEANING AND PROTECTION

A. Clean interior of piping. Remove dirt and debris as work progresses.
B. Protect drains during remainder of construction period to avoid clogging with dirt and debris and to prevent damage from traffic and construction work.
C. Place plugs in ends of uncompleted piping at end of day and when work stops.

3.09 PIPING SCHEDULE

A. Flanges and unions may be used on aboveground pressure piping unless otherwise indicated.
B. Aboveground, soil and waste piping NPS 3 and smaller shall be the following:
   1. Hubless, cast-iron soil pipe and fittings CISPI hubless-piping couplings; and coupled joints.
   2. Dissimilar Pipe-Material Couplings: Shielded, nonpressure transition couplings.
C. Aboveground, soil and waste piping NPS 4 and larger shall be the following:
   1. Hubless, cast-iron soil pipe and fittings heavy-duty hubless-piping couplings; and coupled joints.
   2. Dissimilar Pipe-Material Couplings: Shielded, nonpressure transition couplings.
D. Aboveground, vent piping NPS 3 and smaller shall be the following:
   1. Hubless, cast-iron soil pipe and fittings CISPI hubless-piping couplings; and coupled joints.
   2. Dissimilar Pipe-Material Couplings: Shielded, nonpressure transition couplings.
E. Aboveground, vent piping NPS 4 and larger shall be the following:
   1. Hubless, cast-iron soil pipe and fittings CISPI hubless-piping couplings; and coupled joints.
   2. Dissimilar Pipe-Material Couplings: Unshielded, nonpressure transition couplings.
F. Underground, soil, waste, and vent piping NPS 3 and smaller shall be any of the following:
   1. Solid-wall PVC pipe, PVC socket fittings, and solvent-cemented joints, unless noted otherwise on the drawings.
   2. Hubless, cast-iron soil pipe and fittings CISPI hubless-piping couplings; and coupled joints.
   3. Dissimilar Pipe-Material Couplings: Shielded, nonpressure transition couplings.
G. Underground, soil, waste and vent piping NPS 4 and larger shall be any of the following:
   1. Solid-wall PVC pipe, PVC socket fittings, and solvent-cemented joints, unless noted otherwise on the drawings.
   2. Hubless, cast-iron soil pipe and fittings CISPI hubless-piping couplings; and coupled joints.
   3. Dissimilar Pipe-Material Couplings: Shielded, nonpressure transition couplings.

END OF SECTION 22 1316

SECTION 22 1319 - SANITARY WASTE PIPING SPECIALTIES

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Furnish all labor, materials, equipment, tools and services required to fully complete all Sanitary Waste Pipe work as is indicated on the drawings and/or specified herein including, but not limited to, the following described items.

1. Cleanouts.
2. Floor drains.
3. Roof flashing assemblies.
4. Through-penetration firestop assemblies.
5. Miscellaneous sanitary drainage piping specialties.
6. Flashing materials.

1.02 RELATED REQUIREMENTS

A. Division 22 Section "Storm Drainage Piping Specialties" for trench drains for storm water, channel drainage systems for storm water, roof drains, and catch basins.

1.03 SEISMIC REQUIREMENTS

A. Seismic Performance: Plumbing equipment, hangers and supports shall withstand the effects of earthquake motions determined according to SEI/ASCE 7 and with the requirements specified in Section 22 0548 “Vibration and Seismic Controls for Plumbing Piping and Equipment.

1.04 DEFINITIONS

A. FOG: Fats, oils, and greases.

B. FRP: Fiberglass-reinforced plastic.

C. HDPE: High-density polyethylene plastic.

D. PE: Polyethylene plastic.

E. PP: Polypropylene plastic.

F. PVC: Polyvinyl chloride plastic.

1.05 SUBMITTALS

A. Product Data: For each type of product indicated.

B. Field quality-control test reports.

C. Operation and Maintenance Data: For drainage piping specialties to include in emergency, operation, and maintenance manuals.

1.06 QUALITY ASSURANCE

A. Drainage piping specialties shall bear label, stamp, or other markings of specified testing agency.

B. Comply with NSF 14, "Plastics Piping Components and Related Materials," for plastic sanitary piping specialty components.

1.07 COORDINATION

A. Coordinate size and location of concrete bases. Cast anchor-bolt inserts into bases. Concrete, reinforcement, and formwork requirements are specified in Division 03.

B. Coordinate size and location of roof penetrations.

PART 2 PRODUCTS

2.01 CLEANOUTS

A. Exposed Metal Cleanouts:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. Josam Company; Josam Div.
   b. MIFAB, Inc.
   c. Smith, Jay R. Mfg. Co.; Division of Smith Industries, Inc.
   d. Tyler Pipe; Wade Div.
   e. Watts Drainage Products Inc.
   f. Zurn Plumbing Products Group; Specification Drainage Operation.
2. Standard: ASME A112.36.2M for cast iron for cleanout test tee.
3. Size: Same as connected drainage piping
4. Body Material: Hubless, cast-iron soil pipe test tee as required to match connected piping.
5. Closure: Countersunk, brass plug.
6. Closure Plug Size: Same as or not more than one size smaller than cleanout size.
7. Closure: Stainless-steel plug with seal.

B. Metal Floor Cleanouts:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. Josam Company; Josam Div.
   b. Oatey.
   c. Smith, Jay R. Mfg. Co.; Division of Smith Industries, Inc.

d. Tyler Pipe; Wade Div.
e. Watts Drainage Products Inc.
f. Zurn Plumbing Products Group; Light Commercial Operation.
g. Zurn Plumbing Products Group; Specification Drainage Operation.

2. Standard: ASME A112.36.2M for adjustable housing cleanout.
3. Size: Same as connected branch.
4. Type: Adjustable housing.
5. Body or Ferrule: Cast iron.
6. Clamping Device: Required.
7. Outlet Connection: Inside calk.
8. Closure: Brass plug with tapered threads.
9. Adjustable Housing Material: Cast iron with threads.
10. Frame and Cover Material and Finish: Nickel-bronze, copper alloy.
11. Frame and Cover Shape: Round.
12. Top Loading Classification: Heavy Duty.
13. Riser: ASTM A 74, Service class, cast-iron drainage pipe fitting and riser to cleanout.
14. Standard: ASME A112.3.1.
15. Size: Same as connected branch.
16. Housing: Stainless steel.
17. Closure: Stainless steel with seal.
18. Riser: Stainless-steel drainage pipe fitting to cleanout.

C. Cast-Iron Wall Cleanouts:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. Josam Company; Josam Div.
   b. MIFAB, Inc.
   c. Smith, Jay R. Mfg. Co.; Division of Smith Industries, Inc.
   d. Tyler Pipe; Wade Div.
   e. Watts Drainage Products Inc.
   f. Zurn Plumbing Products Group; Specification Drainage Operation.
2. Standard: ASME A112.36.2M. Include wall access.
3. Size: Same as connected drainage piping.
4. Body: Hub-and-spigot, cast-iron soil pipe T-branch as required to match connected piping.
5. Closure: Countersunk, brass plug.
6. Closure Plug Size: Same as or not more than one size smaller than cleanout size.
7. Wall Access: Round, flat, chrome-plated brass or stainless-steel cover plate with screw.
8. Wall Access: Round, stainless-steel wall-installation frame and cover.

2.02 FLOOR DRAINS

A. Drains:

1. Floor Drain (FD-1):
   a. Duco cast-iron body, flashing collar, 6 inch diameter stainless steel adjustable strainer. Provide with deep seal trap and trap seal protection device.
   b. Approved Manufacturers:
      1) Josam – 30000-S-SS-T
      2) Zurn - Z-415-SZ1
      3) Zurn – FD-2321-ST
   c. Deep seal trap with clean out plug.
   d. Approved Manufacturers:
      1) J.R. Smith 7220
      2) Zurn Z-1000
      3) Mifab
      4) Josam
   e. Delete clean out plug on drains used for slab-on-grade installation.
   f. Install 36 inch by 36 inch by 4 lb/sq ft lead pan.
2. Floor Drain (FD-2):
   a. Medium Duty, cast iron slotted grate and body with bottom outlet 9” diameter, sediment bucket, flashing clamp and frame. Provide with deep seal trap and trap seal protection device.
   b. Approved Manufacturers:
      1) J.R Smith 2110-B
      2) Josam 32100AE-81
      3) Zurn Z-550-Y
      4) Mifab
   c. Deep seal trap with clean out plug.
   d. Approved Manufacturers:
      1) J.R. Smith 7220
      2) Zurn Z-1000
      3) Mifab
      4) Josam
   e. Delete clean out plug on drains used for slab-on-grade installation.

2.03 MISCELLANEOUS SANITARY DRAINAGE PIPING SPECIALTIES

A. Deep-Seal Traps:

1. Description: Cast-iron or bronze casting, with inlet and outlet matching connected piping.
2. Size: Same as connected waste piping.
   a. NPS 2: 4-inch- minimum water seal.
   b. NPS 2-1/2 and Larger: 5-inch- minimum water seal.

B. Floor-Drain, Trap-Seal Device:

1. Description: EPDM trap seal device, IAPMO listed.

C. Air-Gap Fittings:

1. Standard: ASME A112.1.2, for fitting designed to ensure fixed, positive air gap between installed inlet and outlet piping.
2. Body: Bronze or cast iron.
3. Inlet: Opening in top of body.
4. Outlet: Larger than inlet.
5. Size: Same as connected waste piping and with inlet large enough for associated indirect waste piping.

2.04 FLASHING MATERIALS

A. Elastic Membrane Sheet: ASTM D 4068, flexible, chlorinated polyethylene, 40-mil minimum thickness.

B. Fasteners: Metal compatible with material and substrate being fastened.

C. Metal Accessories: Sheet metal strips, clamps, anchoring devices, and similar accessory units required for installation; matching or compatible with material being installed.

D. Bituminous Coating: SSPC-Paint 12, solvent-type, bituminous mastic.

PART 3 EXECUTION

3.01 INSTALLATION

A. Comply with requirements for seismic-restraint devices in Section 220548 "Vibration and Seismic Controls for Plumbing Piping and Equipment."

B. Refer to Division 22 Section "Common Work Results for Plumbing" for piping joining materials, joint construction, and basic installation requirements.

C. Install backwater valves in building drain piping. For interior installation, provide cleanout deck plate flush with floor and centered over backwater valve cover, and of adequate size to remove valve cover for servicing.

D. Install cleanouts in aboveground piping and building drain piping according to the following, unless otherwise indicated:

1. Size same as drainage piping up to NPS 4. Use NPS 4 for larger drainage piping unless larger cleanout is indicated.
2. Locate at each change in direction of piping greater than 45 degrees.
3. Locate at minimum intervals of 50 feet for piping NPS 4 and smaller and 100 feet for larger piping.
4. Locate at base of each vertical soil and waste stack.

E. For floor cleanouts for piping below floors, install cleanout deck plates with top flush with finished floor.

F. For cleanouts located in concealed piping, install cleanout wall access covers, of types indicated, with frame and cover flush with finished wall.

G. Install floor drains at low points of surface areas to be drained. Set grates of drains flush with finished floor, unless otherwise indicated.

1. Position floor drains for easy access and maintenance.
2. Set floor drains below elevation of surrounding finished floor to allow floor drainage. Set with grates depressed according to the following drainage area radii:
   a. Radius, 30 Inches or Less: Equivalent to 1 percent slope, but not less than 1/4-inch total depression.
   b. Radius, 30 to 60 Inches: Equivalent to 1 percent slope.
   c. Radius, 60 Inches or Larger: Equivalent to 1 percent slope, but not greater than 1-inch total depression.
3. Install floor-drain flashing collar or flange so no leakage occurs between drain and adjoining flooring. Maintain integrity of waterproof membranes where penetrated.
4. Install individual traps for floor drains connected to sanitary building drain, unless otherwise indicated.

H. Assemble plastic channel drainage system components according to manufacturer's written instructions. Install on support devices so that top will be flush with adjacent surface.

I. Assemble stainless steel channel drainage system components according to manufacturer's written instructions. Install on support devices so that top will be flush with adjacent surface.

J. Install deep-seal traps on all floor drains and other waste outlets, if indicated.

K. Install floor-drain, trap-seal primer fittings on inlet to floor drains that require trap-seal primer connection.

1. Exception: Fitting may be omitted if trap has trap-seal primer connection.
2. Size: Same as floor drain inlet.

L. Install air-gap fittings on draining-type backflow preventers and on indirect-waste piping discharge into sanitary drainage system.

M. Install sleeve flashing device with each riser and stack passing through floors with waterproof membrane.

N. Install vent cap filters on each vent pipe passing through roof.

O. Install wood-blocking reinforcement for wall-mounting-type specialties.

P. Install traps on plumbing specialty drain outlets. Omit traps on indirect wastes unless trap is indicated.

Q. Install escutcheons at wall, floor, and ceiling penetrations in exposed finished locations and within cabinets and millwork. Use deep-pattern escutcheons if required to conceal protruding pipe fittings.

3.02 CONNECTIONS

A. Piping installation requirements are specified in other Division 22 Sections. Drawings indicate general arrangement of piping, fittings, and specialties.

B. Install piping adjacent to equipment to allow service and maintenance.

3.03 FLASHING INSTALLATION

A. Fabricate flashing from single piece unless large pans, sumps, or other drainage shapes are required. Join flashing according to the following if required:

1. Lead Sheets: Burn joints of lead sheets 6.0-lb/sq. ft., 0.0938-inch thickness or thicker. Solder joints of lead sheets 4.0-lb/sq. ft., 0.0625-inch thickness or thinner.

B. Install sheet flashing on pipes, sleeves, and specialties passing through or embedded in floors and roofs with waterproof membrane.

1. Pipe Flashing: Sleeve type, matching pipe size, with minimum length of 10 inches, and skirt or flange extending at least 8 inches around pipe.
2. Sleeve Flashing: Flat sheet, with skirt or flange extending at least 8 inches around sleeve.
3. Embedded Specialty Flashing: Flat sheet, with skirt or flange extending at least 8 inches around specialty.

C. Set flashing on floors and roofs in solid coating of bituminous cement.

D. Secure flashing into sleeve and specialty clamping ring or device.

E. Install flashing for piping passing through roofs with counterflashing or commercially made flashing fittings, according to Division 07 Section "Sheet Metal Flashing and Trim."

F. Extend flashing up vent pipe passing through roofs and turn down into pipe, or secure flashing into cast-iron sleeve having calking recess.

G. Fabricate and install flashing and pans, sumps, and other drainage shapes.

3.04 FIELD QUALITY CONTROL

A. Perform tests and inspections and prepare test reports.

B. Tests and Inspections:

1. Leak Test: After installation, charge system and test for leaks. Repair leaks and retest until no leaks exist.
2. Test and adjust controls and safety. Replace damaged and malfunctioning controls and equipment.

3.05 PROTECTION

A. Protect drains during remainder of construction period to avoid clogging with dirt or debris and to prevent damage from traffic or construction work.

B. Place plugs in ends of uncompleted piping at end of each day or when work stops.

END OF SECTION 22 1319

SECTION 22 1413 - FACILITY STORM DRAINAGE PIPING

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Furnish all labor, materials, equipment, tools and services required to fully complete all Storm Drain work as is indicated on the drawings and/or specified herein including, but not limited to, the following described items.
   1. Storm drainage piping inside the building:
      a. Pipe, tube, and fittings.
      b. Special pipe fittings.

1.02 PERFORMANCE REQUIREMENTS

A. Components and installation shall be capable of withstanding the following minimum working-pressure, unless otherwise indicated:
   1. Storm Drainage Piping: 40-foot head of water.
B. Seismic Performance: Plumbing equipment, hangers and supports shall withstand the effects of earthquake motions determined according to SEI/ASCE 7 and with the requirements specified in Section 22 0548 “Vibration and Seismic Controls for Plumbing Piping and Equipment.
   1. For components with a seismic importance factor of 1.0 the term "withstand" means "the system will remain in place without separation of any parts when subjected to the seismic forces specified."
   2. For components with a seismic importance factor of 1.5 the term "withstand" means "the system will remain in place without separation of any parts when subjected to the seismic forces specified and the system will be fully operational after the seismic event."

1.03 SUBMITTALS

A. Product Data: For pipe, tube, fittings, and couplings.
B. Shop Drawings:
   1. Controlled-Flow Storm Drainage System: Include calculations, plans, and details.
C. Field quality-control inspection and test reports.
D. Delegated-Design Submittal:
   1. Design calculations and detailed fabrication and assembly of pipe anchors and alignment guides, hangers and supports for multiple pipes, expansion joints and loops, and attachments of the same to the building structure.
   2. Locations of pipe anchors and alignment guides and expansion joints and loops.
   3. Locations of and details for penetrations, including sleeves and sleeve seals for exterior walls, floors, basement, and foundation walls.

1.04 QUALITY ASSURANCE

A. Piping materials shall bear label, stamp, or other markings of specified testing agency.

B. Comply with NSF 14, "Plastics Piping Systems Components and Related Materials," for plastic piping components. Include marking with "NSF-drain" for plastic drain piping and "NSF-sewer" for plastic sewer piping.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. In other Part 2 articles where titles below introduce lists, the following requirements apply to product selection:
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the manufacturers specified.

2.02 PIPING MATERIALS

A. Refer to Part 3 "Piping Applications" Article for applications of pipe, tube, fitting, and joining materials.

2.03 HUBLESS CAST-IRON SOIL PIPE AND FITTINGS

A. Pipe and Fittings: ASTM A 888 or CISPI 301. All waste, vent, sewer and storm lines shall be soil pipe and fittings that conform to the requirements of CISPI Standard 301, ASTM A ** and shall be marked with the collective trademark of the Cast Soil Pipe Institute or Receive Prior approval of the engineer and manufactured by AB&I Foundry, Tyler Pipe, or Charlotte Pipe. In addition all Cast iron shall be American made and tested, no “non compliant” import cast iron will be permitted.
B. Extra Heavy-Duty, Hubless-Piping Couplings:
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      a. Husky HD 4000.
      b. Clamp-All Corp.
      c. Ideal.
      d. Mission.
      e. Tyler Pipe.
   2. Standards: ASTM C 1540.
   3. Description: Stainless-steel shield with stainless-steel bands and tightening devices; and ASTM C 564, rubber sleeve with integral, center pipe stop.

2.04 SPECIAL PIPE FITTINGS

A. Flexible, Nonpressure Pipe Couplings: Comply with ASTM C 1173, elastomeric, sleeve-type, reducing or transition pattern. Include shear ring, ends of same sizes as piping to be joined, and corrosion-resistant-metal tension band and tightening mechanism on each end.
   1. Manufacturers:
      a. Dallas Specialty & Mfg. Co.
      b. Fernco, Inc.

c. Logan Clay Products Company (The).
d. Mission Rubber Co.
e. NDS, Inc.
f. Plastic Oddities, Inc.

2. Sleeve Materials:
a. For Cast-Iron Soil Pipes: ASTM C 564, rubber.
b. For Plastic Pipes: ASTM F 477, elastomeric seal or ASTM D 5926, PVC.
c. For Dissimilar Pipes: ASTM D 5926, PVC or other material compatible with pipe materials being joined.

B. Shielded Nonpressure Pipe Couplings: ASTM C 1460, elastomeric or rubber sleeve with full-length, corrosion-resistant outer shield and corrosion-resistant-metal tension band and tightening mechanism on each end.
1. Manufacturers:
a. Cascade Waterworks Mfg. Co.
b. Mission Rubber Co.

PART 3 EXECUTION

3.01 EXCAVATION

A. Refer to Division 31 Section "Earth Moving" for excavating, trenching, and backfilling.

3.02 PIPING APPLICATIONS

A. Aboveground storm drainage piping shall be the following:
1. Hubless cast-iron soil pipe and fittings; Extra heavy-duty shielded, stainless-steel couplings; and coupled joints.

B. Underground and crawl space storm drainage piping shall be the following (6” above finished floor):
1. Solid-wall PVC pipe, PVC socket fittings, and solvent-cemented joints.
2. Hub-and spigot cast-iron soil pipe, hub-and spigot cast-iron soil pipe fittings, neoprene rubber gasket, and compression joints.

3.03 PIPING INSTALLATION

A. Storm sewer and drainage piping outside the building are specified in Division 33 Section "Storm Utility Drainage Piping."
B. Comply with SEI/ASCE 7 and with requirements for seismic-restraint devices in Section 220548 "Vibration and Seismic Controls for Plumbing Piping and Equipment."
C. Basic piping installation requirements are specified in Division 22 Section "Common Work Results for Plumbing."
D. Install cleanouts at grade and extend to where building storm drains connect to building storm sewers. Cleanouts are specified in Division 22 Section "Storm Drainage Piping Specialties."
E. Install cleanout fitting with closure plug inside the building in storm drainage force-main piping.

Install cast-iron sleeve with water stop and mechanical sleeve seal at each service pipe penetration through foundation wall. Select number of interlocking rubber links required to make installation watertight. Sleeves and mechanical sleeve seals are specified in Division 22 Section "Common Work Results for Fire Plumbing."

F. Install cast-iron soil piping according to CISPI's "Cast Iron Soil Pipe and Fittings Handbook," Chapter IV, "Installation of Cast Iron Soil Pipe and Fittings."
   1. Install encasement on underground piping according to ASTM A 674 or AWWA C105.
G. Make changes in direction for storm drainage piping using appropriate branches, bends, and long-sweep bends. Do not change direction of flow more than 90 degrees. Use proper size of standard increasers and reducers if pipes of different sizes are connected. Reducing size of drainage piping in direction of flow is prohibited.
H. Lay buried building storm drainage piping beginning at low point of each system. Install true to grades and alignment indicated, with unbroken continuity of invert. Place hub ends of piping upstream. Install required gaskets according to manufacturer's written instructions for use of lubricants, cements, and other installation requirements. Maintain swab in piping and pull past each joint as completed.
I. Install storm drainage piping at the following minimum slopes, unless otherwise indicated:
   1. Building Storm Drain: 1 percent downward in direction of flow for piping NPS 3 and smaller; 1 percent downward in direction of flow for piping NPS 4 and larger.
   2. Horizontal Storm-Drainage Piping: 1 percent downward in direction of flow.
J. Sleeves are not required for cast-iron soil piping passing through concrete slabs-on-grade if slab is without membrane waterproofing.
K. Install underground PVC storm drainage piping according to ASTM D 2321.
L. Do not enclose, cover, or put piping into operation until it is inspected and approved by authorities having jurisdiction.

3.04 JOINT CONSTRUCTION

A. Basic piping joint construction requirements are specified in Division 22 Section "Common Work Results Plumbing."
B. Hubless Cast-Iron Soil Piping Coupled Joints: Join according to CISPI 310 and CISPI's "Cast Iron Soil Pipe and Fittings Handbook" for hubless-coupling joints.
C. PVC Nonpressure Piping Joints: Join piping according to ASTM D 2665.

3.05 HANGER AND SUPPORT INSTALLATION

A. Seismic-restraint devices are specified in Division 22 Section "Vibration and Seismic Controls for Plumbing Piping and Equipment."
B. Pipe hangers and supports are specified in Division 22 Section "Hangers and Supports for Plumbing Piping and Equipment." Install the following:
   1. Vertical Piping: MSS Type 8 or Type 42, clamps.
   2. Individual, Straight, Horizontal Piping Runs: According to the following:
      a. 100 Feet and Less: MSS Type 1, adjustable, steel clevis hangers.
      b. Longer than 100 Feet: MSS Type 43, adjustable roller hangers.

c. Longer than 100 Feet, if indicated: MSS Type 49, spring cushion rolls.

3. Multiple, Straight, Horizontal Piping Runs 100 Feet or Longer: MSS Type 44, pipe rolls. Support pipe rolls on trapeze.
4. Base of Vertical Piping: MSS Type 52, spring hangers.

C. Install supports according to Division 22 Section "Hangers and Supports for Plumbing Piping and Equipment."
D. Support vertical piping and tubing at base and at each floor.
E. Rod diameter may be reduced 1 size for double-rod hangers, with 3/8-inch minimum rods.
F. Install hangers for cast-iron soil piping with the following maximum horizontal spacing and minimum rod diameters:
1. NPS 1-1/2 and NPS 2: 60 inches with 3/8-inch rod.
2. NPS 3: 60 inches with 1/2-inch rod.
3. NPS 4 and NPS 5: 60 inches with 5/8-inch rod.
4. NPS 6: 60 inches with 3/4-inch rod.
5. NPS 8 to NPS 12: 60 inches with 7/8-inch rod.
6. Spacing for 10-foot lengths may be increased to 10 feet. Spacing for fittings is limited to 60 inches.

G. Install supports for vertical cast-iron soil piping every 15 feet.
H. Install hangers for PVC piping with the following maximum horizontal spacing and minimum rod diameters:
1. NPS 1-1/2 and NPS: 48 inches with 3/8-inch rod.
2. NPS 3: 48 inches with 1/2-inch rod.
3. NPS 4 and NPS 5: 48 inches with 5/8-inch rod.
4. NPS 6 and NPS 8: 48 inches with 3/4-inch rod.
5. NPS 10 and NPS 12: 48 inches with 7/8-inch rod.

I. Install supports for vertical PVC piping every 48 inches.
J. Support piping and tubing not listed above according to MSS SP-69 and manufacturer's written instructions.

3.06 CONNECTIONS

A. Drawings indicate general arrangement of piping, fittings, and specialties.
B. Connect interior storm drainage piping to exterior storm drainage piping. Use transition fitting to join dissimilar piping materials.
C. Connect storm drainage piping to roof drains and storm drainage specialties.

3.07 FIELD QUALITY CONTROL

A. During installation, notify authorities having jurisdiction at least 24 hours before inspection must be made. Perform tests specified below in presence of authorities having jurisdiction.
1. Roughing-in Inspection: Arrange for inspection of piping before concealing or closing-in after roughing-in.
2. Final Inspection: Arrange for final inspection by authorities having jurisdiction to observe tests specified below and to ensure compliance with requirements.

B. Reinspection: If authorities having jurisdiction find that piping will not pass test or inspection, make required corrections and arrange for reinspection.
C. Reports: Prepare inspection reports and have them signed by authorities having jurisdiction.
D. Test storm drainage piping according to procedures of authorities having jurisdiction or, in absence of published procedures, as follows:
    1. Test for leaks and defects in new piping and parts of existing piping that have been altered, extended, or repaired. If testing is performed in segments, submit separate report for each test, complete with diagram of portion of piping tested.
    2. Leave uncovered and unconcealed new, altered, extended, or replaced storm drainage piping until it has been tested and approved. Expose work that was covered or concealed before it was tested.
    3. Test Procedure: Test storm drainage piping on completion of roughing-in. Close openings in piping system and fill with water to point of overflow, but not less than 10-foot head of water. From 15 minutes before inspection starts to completion of inspection, water level must not drop. Inspect joints for leaks.
    4. Repair leaks and defects with new materials and retest piping, or portion thereof, until satisfactory results are obtained.
    5. Prepare reports for tests and required corrective action.

3.08 CLEANING

A. Clean interior of piping. Remove dirt and debris as work progresses.
B. Protect drains during remainder of construction period to avoid clogging with dirt and debris and to prevent damage from traffic and construction work.
C. Place plugs in ends of uncompleted piping at end of day and when work stops.

END OF SECTION 22 1413

SECTION 22 1423 - STORM DRAINAGE PIPING SPECIALTIES

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Furnish all labor, materials, equipment, tools and services required to fully complete all Storm Drain work as is indicated on the drawings and/or specified herein including, but not limited to, the following described items.
   1. Cleanouts.
   2. Roof drains.
   3. Miscellaneous storm drainage piping specialties.
   4. Flashing materials.

1.02 RELATED REQUIREMENTS

A. Division 22 Section "Sanitary Waste Piping Specialties" for backwater valves, floor drains, trench drains and channel drainage systems connected to sanitary sewer, air admittance valves, FOG disposal systems, grease interceptors and removal devices, oil interceptors, and solid interceptors.

1.03 DEFINITIONS

A. FOG: Fats, oils, and greases.
B. PUR: Polyurethane plastic.
C. PVC: Polyvinyl chloride plastic.

1.04 SUBMITTALS

A. Product Data: For each type of product indicated.

1.05 QUALITY ASSURANCE

A. Drainage piping specialties shall bear label, stamp, or other markings of specified testing agency.

1.06 COORDINATION

A. Coordinate size and location of roof penetrations.

PART 2 PRODUCTS

2.01 CLEANOUTS

A. Exposed Metal Cleanouts:
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      a. Josam Company; Josam Div.

b. MIFAB, Inc.
c. Smith, Jay R. Mfg. Co.; Division of Smith Industries, Inc.
d. Sioux Chief Manufacturing Company, Inc
e. Tyler Pipe; Wade Div.
f. Watts Drainage Products Inc.
g. Zurn Plumbing Products Group; Specification Drainage Operation.

2. Standard: ASME A112.36.2M for cast iron for cleanout test tee.
3. Size: Same as connected drainage piping
4. Body Material: Hubless, cast-iron soil pipe test tee as required to match connected piping.
5. Closure: Countersunk, brass plug.
6. Closure Plug Size: Same as or not more than one size smaller than cleanout size.
7. Closure: Stainless-steel plug with seal.

B. Metal Floor Cleanouts:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
a. Josam Company; Josam Div.
b. Oatey.
c. Sioux Chief Manufacturing Company, Inc.
d. Smith, Jay R. Mfg. Co.; Division of Smith Industries, Inc.
e. Tyler Pipe; Wade Div.
f. Watts Drainage Products Inc.
g. Zurn Plumbing Products Group; Light Commercial Operation.
h. Zurn Plumbing Products Group; Specification Drainage Operation.
2. Standard: ASME A112.36.2M for adjustable housing cleanout.
3. Size: Same as connected branch.
4. Type: Adjustable housing.
5. Body or Ferrule: Cast iron.
6. Clamping Device: Required.
7. Outlet Connection: Inside calk.
8. Closure: [Brass plug with tapered threads.
9. Adjustable Housing Material: Cast iron with threads.
10. Frame and Cover Material and Finish: Stainless steel.
11. Frame and Cover Shape: Round.
12. Top Loading Classification: Heavy Duty.
13. Riser: ASTM A 74, Service class, cast-iron drainage pipe fitting and riser to cleanout.
14. Standard: ASME A112.3.1.
15. Size: Same as connected branch.
16. Housing: Stainless steel.
17. Closure: Stainless steel with seal.
18. Riser: Stainless-steel drainage pipe fitting to cleanout.

C. Cast-Iron Wall Cleanouts:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Josam Company; Josam Div.
b. MIFAB, Inc.
c. Smith, Jay R. Mfg. Co.; Division of Smith Industries, Inc.
d. Sioux Chief Manufacturing Company, Inc
e. Tyler Pipe; Wade Div.
f. Watts Drainage Products Inc.
g. Zurn Plumbing Products Group; Specification Drainage Operation.

2. Standard: ASME A112.36.2M. Include wall access.
3. Size: Same as connected drainage piping.
4. Body: Hubless, cast-iron soil pipe test tee as required to match connected piping.
5. Closure: Countersunk, brass plug.
6. Closure Plug Size: Same as or not more than one size smaller than cleanout size.
7. Wall Access: Round, flat, chrome-plated brass or stainless-steel cover plate with screw.

2.02 ROOF DRAINS

1. Roof Drains (RD):
   a. Size - As shown on Drawings.
   b. Duco cast iron body, with adjustable extension, reversible collar flashing clamp, gravel stop, underdeck clamp, sump receiver, and cast iron dome.
   c. Approved Manufacturers:
      1) JR Smith - 1015
      2) Zurn - Z 100 EA
      3) Josam
      4) Mifab
2. Overflow (Secondary) Roof Drains (SRD):
   a. Size - As shown on Drawings.
   b. Duco cast iron body, with water dam collar, gravel stop, underdeck clamp, sump receiver, and cast iron dome.
   c. Approved Manufacturers:
      1) JR Smith - 1080 with 1015 extension
      2) Zurn - Z 100 EA-89
      3) Josam
      4) Mifab
3. Down Spout Nozzle (DSN):
   a. Size as shown on Drawings
   b. Cast plain bronze downspout and flange
   c. Approved Manufacturers:
      1) JR Smith - 1770
      2) Zurn - Z-199

2.03 FLASHING MATERIALS

A. Elastic Membrane Sheet: ASTM D 4068, flexible, chlorinated polyethylene, 40-mil minimum thickness.

B. Fasteners: Metal compatible with material and substrate being fastened.
C. Metal Accessories: Sheet metal strips, clamps, anchoring devices, and similar accessory units required for installation; matching or compatible with material being installed.
D. Bituminous Coating: SSPC-Paint 12, solvent-type, bituminous mastic.

PART 3 EXECUTION

3.01 INSTALLATION

A. Refer to Division 22 Section "Common Work Results for Plumbing" for piping joining materials, joint construction, and basic installation requirements.
B. Install cleanouts in aboveground piping and building drain piping according to the following, unless otherwise indicated:
    1. Size same as drainage piping up to NPS 4. Use NPS 4 for larger drainage piping unless larger cleanout is indicated.
    2. Locate at each change in direction of piping greater than 45 degrees.
    3. Locate at minimum intervals of 50 feet for piping NPS 4 and smaller and 100 feet for larger piping.
    4. Locate at base of each vertical soil and waste stack.
C. For floor cleanouts for piping below floors, install cleanout deck plates with top flush with finished floor.
D. For cleanouts located in concealed piping, install cleanout wall access covers, of types indicated, with frame and cover flush with finished wall.
E. Install roof drains at low points of roof areas according to roof membrane manufacturer's written installation instructions. Roofing materials are specified in Division 07.
    1. Install roof-drain flashing collar or flange so that there will be no leakage between drain and adjoining roofing. Maintain integrity of waterproof membranes where penetrated.
    2. Position roof drains for easy access and maintenance.
F. Install manufactured, gray-iron downspout boots at grade with top 18 inches above grade. Secure to building wall.
G. Install conductor nozzles at exposed bottom of conductors where they spill onto grade.
H. Install escutcheons at wall, floor, and ceiling penetrations in exposed finished locations and within cabinets and millwork. Use deep-pattern escutcheons if required to conceal protruding pipe fittings.

3.02 CONNECTIONS

A. Piping installation requirements are specified in other Division 22 Sections. Drawings indicate general arrangement of piping, fittings, and specialties.

3.03 FLASHING INSTALLATION

A. Fabricate flashing from single piece unless large pans, sumps, or other drainage shapes are required. Join flashing according to the following if required:

1. Lead Sheets: Burn joints of lead sheets 6.0-lb/sq. ft., 0.0938-inch thickness or thicker. Solder joints of lead sheets 4.0-lb/sq. ft., 0.0625-inch thickness or thinner.

B. Install sheet flashing on pipes, sleeves, and specialties passing through or embedded in floors and roofs with waterproof membrane.
   1. Pipe Flashing: Sleeve type, matching pipe size, with minimum length of 10 inches, and skirt or flange extending at least 8 inches around pipe.
   2. Sleeve Flashing: Flat sheet, with skirt or flange extending at least 8 inches around sleeve.
   3. Embedded Specialty Flashing: Flat sheet, with skirt or flange extending at least 8 inches around specialty.
C. Set flashing on floors and roofs in solid coating of bituminous cement.
D. Secure flashing into sleeve and specialty clamping ring or device.
E. Fabricate and install flashing and pans, sumps, and other drainage shapes.

3.04 PROTECTION

A. Protect drains during remainder of construction period to avoid clogging with dirt or debris and to prevent damage from traffic or construction work.
B. Place plugs in ends of uncompleted piping at end of each day or when work stops.

END OF SECTION 22 1423

SECTION 22 4000 - PLUMBING FIXTURES

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Furnish all labor, materials, equipment, tools and services required to fully complete all Plumbing Fixture work as is indicated on the drawings and/or specified herein including, but not limited to, the following described items.

1. The following conventional plumbing fixtures and related components:
    a. Water Closet
    b. Urinals
    c. Lavatories
    d. Sink
    e. Service Sink
    f. Ice Maker Connection Box
    g. Electric Water Cooler
    h. Trim and Accessories

B. RELATED REQUIREMENTS

1. Division 10 Section "Toilet, Bath, and Laundry Accessories."
2. Division 22 Section "Domestic Water Piping Specialties" for backflow preventers, floor drains, and specialty fixtures not included in this Section.
3. Division 22 Section "Emergency Plumbing Fixtures."
4. Division 22 Section "Drinking Fountains and Water Coolers."

1.02 DEFINITIONS

A. Accessible Fixture: Plumbing fixture that can be approached, entered, and used by people with disabilities.

B. Cast Polymer: Cast-filled-polymer-plastic material. This material includes cultured-marble and solid-surface materials.

C. Cultured Marble: Cast-filled-polymer-plastic material with surface coating.

D. Fitting: Device that controls the flow of water into or out of the plumbing fixture. Fittings specified in this Section include supplies and stops, faucets and spouts, shower heads and tub spouts, drains and tailpieces, and traps and waste pipes. Piping and general-duty valves are included where indicated.

E. FRP: Fiberglass-reinforced plastic.

F. PMMA: Polymethyl methacrylate (acrylic) plastic.

G. PVC: Polyvinyl chloride plastic.

H. Solid Surface: Nonporous, homogeneous, cast-polymer-plastic material with heat-, impact-, scratch-, and stain-resistance qualities.

1. SUBMITTALS
    a. Product Data: For each type of plumbing fixture indicated. Include selected fixture and trim, fittings, accessories, appliances, appurtenances, equipment, and supports. Indicate materials and finishes, dimensions, construction details, and flow-control rates.

I. Shop Drawings: Diagram power, signal, and control wiring.

J. Operation and Maintenance Data: For plumbing fixtures to include in emergency, operation, and maintenance manuals.

K. Warranty: Special warranty specified in this Section.

1.03 QUALITY ASSURANCE

A. Source Limitations: Obtain plumbing fixtures, faucets, and other components of each category through one source from a single manufacturer.
   1. Exception: If fixtures, faucets, or other components are not available from a single manufacturer, obtain similar products from other manufacturers specified for that category.

B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

C. Regulatory Requirements: Comply with requirements in ICC A117.1, "Accessible and Usable Buildings and Facilities"; Public Law 90-480, "Architectural Barriers Act"; and Public Law 101-336, "Americans with Disabilities Act"; for plumbing fixtures for people with disabilities.

D. Regulatory Requirements: Comply with requirements in Public Law 102-486, "Energy Policy Act," about water flow and consumption rates for plumbing fixtures.

E. NSF Standard: Comply with NSF 61, "Drinking Water System Components--Health Effects," for fixture materials that will be in contact with potable water.

F. Select combinations of fixtures and trim, faucets, fittings, and other components that are compatible.

G. Comply with the following applicable standards and other requirements specified for plumbing fixtures:
   1. Enameled, Cast-Iron Fixtures: ASME A112.19.1M.
   2. Vitreous-China Fixtures: ASME A112.19.2M.
   3. Water-Closet, Flushometer Tank Trim: ASSE 1037.

H. Comply with the following applicable standards and other requirements specified for lavatory and sink faucets:
   1. Backflow Protection Devices for Faucets with Hose-Thread Outlet: ASME A112.18.3M.
   2. Faucets: ASME A112.18.1.
   3. Hose-Connection Vacuum Breakers: ASSE 1011.
   4. Hose-Coupling Threads: ASME B1.20.7.
   5. Integral, Atmospheric Vacuum Breakers: ASSE 1001.
   6. NSF Potable-Water Materials: NSF 61.
   7. Pipe Threads: ASME B1.20.1.
   8. Sensor-Actuated Faucets and Electrical Devices: UL 1951.
   9. Supply Fittings: ASME A112.18.1.
   10. Brass Waste Fittings: ASME A112.18.2.
   11. NSF61 Appendage G-AB 1953. Lead free potable drinking faucets.

I. Comply with the following applicable standards and other requirements specified for bathtub/shower and shower faucets:
   1. Backflow Protection Devices for Hand-Held Showers: ASME A112.18.3M.
   2. Combination, Pressure-Equalizing and Thermostatic-Control Antiscald Faucets: ASSE 1016.
   3. Faucets: ASME A112.18.1.
   4. Hand-Held Showers: ASSE 1014.
   5. High-Temperature-Limit Controls for Thermal-Shock-Preventing Devices: ASTM F 445.
   6. Hose-Coupling Threads: ASME B1.20.7.
   7. Manual-Control Antiscald Faucets: ASTM F 444.
   8. Pipe Threads: ASME B1.20.1.
   9. Sensor-Actuated Faucets and Electrical Devices: UL 1951.

J. Comply with the following applicable standards and other requirements specified for miscellaneous fittings:
   1. Atmospheric Vacuum Breakers: ASSE 1001.
   2. Brass and Copper Supplies: ASME A112.18.1.
   3. Manual-Operation Flushometers: ASSE 1037.
   4. Plastic Tubular Fittings: ASTM F 409.
   5. Brass Waste Fittings: ASME A112.18.2.
   6. Sensor-Operation Flushometers: ASSE 1037 and UL 1951.
   7. NSF61 Appendage G-AB 1953. Lead free potable drinking faucets.

K. Comply with the following applicable standards and other requirements specified for miscellaneous components:
   1. Flexible Water Connectors: ASME A112.18.6.
   2. Floor Drains: ASME A112.6.3.
   3. Hose-Coupling Threads: ASME B1.20.7.
   4. Off-Floor Fixture Supports: ASME A112.6.1M.
   5. Pipe Threads: ASME B1.20.1.
   6. Plastic Toilet Seats: ANSI Z124.5.
   7. Supply and Drain Protective Shielding Guards: ICC A117.1.

1.04 EXTRA MATERIALS

A. Furnish extra materials described below that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
   1. Faucet Washers and O-Rings: Equal to 10 percent of amount of each type and size installed.
   2. Faucet Cartridges and O-Rings: Equal to 5 percent of amount of each type and size installed.
   3. Flushometer Valve, Repair Kits: Equal to 10 percent of amount of each type installed, but no fewer than 12 of each type.
   4. Provide hinged-top wood or metal box, or individual metal boxes, with separate compartments for each type and size of extra materials listed above.
   5. Toilet Seats: Equal to 5 percent of amount of each type installed.

PART 2 PRODUCTS

2.01 MANUFACTURED UNITS

A. Water Closets:

1. Tank Type, Standard Fixture (P-1A):
   a. Floor mounted, vitreous china, elongated bowl, 1.6 gallon per flush, 3" gravity flush valve and flush handle to be installed on accessible side of fixture. Color to be white.
   b. Approved Manufacturers:
      (1) Kohler "Kingston" Model No. K-3977-0
      (2) Toto
      (3) Zurn
      (4) Sloan
2. Tank Type, ADA Compliant Fixture (P-1B):
   a. Floor mounted, vitreous china, elongated bowl, 1.6 gallon per flush, 3" gravity flush valve and flush handle to be installed on accessible side of fixture to meet ADA requirements. Color to be white.
   b. Approved Manufacturers:
      (1) Kohler Model No. K-3979-0
      (2) Toto
      (3) Zurn
      (4) Sloan
3. Seats (P-1A and P-1B):
   a. Provide split front type with self-sustaining check hinge.
   b. Approved Manufacturers:
      (1) Kohler - K-4666-C
      (2) Bemis
      (3) Olsonite

B. Urinals:

1. Standard Fixture (P-2A):
   a. Wall Mount, Vitreous China, 3/4" top spud, siphon jet type, 1.0 gpf, 2 inch outlet connection, mount with 24" rim height. Color to be white.
   b. Approved Manufacturers:
      (1) Kohler Model No. K-4989-T-0
      (2) Zurn
      (3) Sloan
2. ADA Compliant Fixture (P-2B):
   a. Wall Mount, Vitreous China, 3/4" top spud, siphon jet type, 1.0 gpf., 2 inch outlet connection, mount with 17 inch rim height. Color to be white.
   b. Approved Manufacturers:
      (1) Kohler Model No. K-4989-T-0
      (2) Zurn
      (3) Sloan

1. Flush Valve (Sensor Operated) (P-2A and P-2B):
   a. Exposed type, chrome plated, piston type flushometer, vacuum breaker flush connection, spud coupling and flange for top spud connection, with side mount battery powered sensor operator, vandal resistant stop cap with set screw, sweat solder adapter with cover tube and cast set screw wall flange.
   b. Approved Manufacturers:
      (1) Zurn
      (2) Sloan Model No. “Gem 2” Model 186-1.0-SMO

B. Lavatories
1. Wall Mounted Lavatory, ADA (P-3):
   a. Wall mounted fixture, 18-1/4” x 21-1/4” x 12-1/4”, vitreous china, front overflow, faucet holes on 4” centers, floor mounted concealed arm carrier. Color to be white.
   b. Approved Manufacturers:
      (1) Kohler “Kingston” Model No. 2007
      (2) Zurn
      (3) Sloan
2. Faucet (P-3):
   a. Chrome Plated Brass, Deck mounted, 4” center set, Electronic hand washing faucet, ADA compliant, 0.5 GPM flow rate, Vandal Resistant spray head, Surface mount control box, Hard wired 24 VAC/6 VDC plug-in adapter. Inlet Checks and Strainer. Furnish with trim plate and Thermostatic Mixing Valve (ASSE1070).
   b. Approved Manufacturers:
      (1) Zurn Model No. Z6913-XL with Honeywell AM100 mixing valve
      (2) Kohler
      (3) Chicago
3. Lavatory Strainer (P-3):
   a. Drain with grid pattern strainer, Cast Brass, Chrome Plated, Provide offset type drain as required to maintain ADA clearances.
   b. Approved Manufacturers:
      (1) Dearborn
      (2) Elkay
      (3) McGuire
      (4) Kohler
4. Service Sink (P-4):
   a. Floor mounted Type, enameled cast iron, 28 by 28 inches with vinyl coated rim guard. 3” threaded outlet and chrome plated flat metal grid strainer with cleanout plug. Color to be white.
   b. Approved Manufacturers:
      (1) Kohler Model No. 6710-0
      (2) CECO

1. Service Sink Faucet (P-4):
   a. Wall mounted mixing faucet, bucket hook, vacuum breaker, integral stops in shanks, polished chrome finish, mounting height of 42 inches above finished floor. Provide 4 ft. of ¾" commercial grade rubber hose with male and female connectors.
   b. Approved Manufacturers:
      (1) T & S Brass B-0665-BSTR
      (2) Kohler
      (3) Chicago
      (4) Zurn

B. Sinks
1. Workroom Sink (P-5):
   a. Undermount fixture, Single Compartment, ADA Sink, 18-gauge 304 Stainless Steel, rear center drain placement, 21-1/2" x 18-1/2" x 5-3/8".
   b. Approved Manufacturers:
      (1) Elkay Model No. ELUHAD191655
      (2) Just
      (3) Acorn
2. Workroom Sink Faucet (P-5):
   a. Deck mounted faucet with gooseneck swing spout, 8" fixed centers, vandal proof 2-3/8" lever handle, ceramic ¼-turn operating cartridge, 1.0 gpm, ASME A112.18.1/CSA B125.1, with 5 yr warranty.
   b. Approved Manufacturers:
      (1) Chicago Faucets Model No. 786-GN8E73-369XKAB
      (2) Kohler
      (3) Moen
3. Workroom Sink Disposal (P-5):
   a. Garbage Disposal, ½ HP motor, with power cord, quick lock mounting system, galvanized steel-grind components.
   b. Approved Manufacturer:
      (1) Insinkerator Badger 5 Garbage Disposal.

C. Electric Water Cooler:
1. Electric Water Cooler (P-6):
   a. Self-contained, wall-hung, bi-level, bottle filler with no filter, front and side pressure operators with cast brass bubbler, air cooled, 7.8 gal. per hour capacity (minimum), with 90^{o} ambient air water entering at 80^{o} and leaving at 50^{o}, stainless steel top. Furnish with supply and stop and PVC p-trap. Five year warranty, 120 volt, 60 cycle, 1 phase power. Order with orientation shown on architectural drawings.
   b. Approved Manufacturers:
      (1) Elkay Model No. EZSTL8WSLK
      (2) Acorn Aqua
      (3) Haws

D. Ice Maker Connection Box:
1. Ice Maker Connection Box (IMC):

a. One-piece box and box and flange design, snap-on frame. Chrome plated ¼ turn adapter ball valve with 1/2" copper sweat connection.
b. Approved Manufacturers:
(1) Oatey
(2) Guy Gray
(3) Water-tite

E. Trim and Accessories:

1. Supplies and Stops:
a. Chrome plated cast brass angle stop, ball type quarter turn valve. Provide with chrome plated escutcheon, compression type connections.
b. Approved Manufacturers:
(1) Brass Craft KT Series ¼ turn
(2) ProFlo
(3) Mainline
(4) McGuire
2. Supply Lines:
a. Provide with braided stainless steel supply lines.
b. Approved Manufacturers:
(1) Zurn – Z8860-12-SS through Z8863-20-SS
(2) Brass Craft – S1-12A through S8-30A
(3) ProFlo
(4) Mainline
3. P-Trap:
a. 17 gauge, tubular brass, chrome plated and chrome escutcheons.
b. Approved Manufacturers:
(1) Dearborn
(2) McGuire
(3) Zurn
(4) ProFlo
(5) Mainline
4. Lavatory Pre-formed Insulation and Protective Cover:
a. Pre-formed foam or fiberglass insulation with two piece white PVC snap on cover with velcro closure, to fit P-trap and hot and cold water stops and supplies, meet 25/50 flame/smoke rating.
b. Approved Manufacturer:
(1) Truebro
(2) Plumberex
(3) ProFlo
(4) Mainline
5. Carriers:
a. Urinal Carriers: Provide floor mounted carrier system with coated steel uprights with welded feet, adjustable top and bottom support plates and mounting fasteners.

b. Lavatory Carriers: Provide floor mounted system with coated steel uprights with welded feet, cast iron adjustable headers, concealed arms, steel sleeves, alignment truss, and mounting fasteners.

c. Electric Water Cooler: Provide floor mounted carrier system with adjustable top and bottom support plates, dura-coated rectangular steel uprights with welded feet and mounting fasteners.

d. Approved Manufacturers:

(1) J. R. Smith
(2) Josam
(3) Wade
(4) Zurn
(5) Mifab

PART 3 EXECUTION

3.01 EXAMINATION

A. Examine roughing-in of water supply and sanitary drainage and vent piping systems to verify actual locations of piping connections before plumbing fixture installation.

B. Examine cabinets, counters, floors, and walls for suitable conditions where fixtures will be installed.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 INSTALLATION

A. Assemble plumbing fixtures, trim, fittings, and other components according to manufacturers' written instructions.

B. Install off-floor supports, affixed to building substrate, for wall-mounting fixtures.
1. Use carrier supports with waste fitting and seal for back-outlet fixtures.
2. Use carrier supports without waste fitting for fixtures with tubular waste piping.
3. Use chair-type carrier supports with rectangular steel uprights for accessible fixtures.

C. Install back-outlet, wall-mounting fixtures onto waste fitting seals and attach to supports.

D. Install floor-mounting fixtures on closet flanges or other attachments to piping or building substrate.

E. Install wall-mounting fixtures with tubular waste piping attached to supports.

F. Install counter-mounting fixtures in and attached to casework.

G. Install fixtures level and plumb according to roughing-in drawings.

H. Install water-supply piping with stop on each supply to each fixture to be connected to water distribution piping. Attach supplies to supports or substrate within pipe spaces behind fixtures. Install stops in locations where they can be easily reached for operation.
1. Exception: Use ball, gate, or globe valves if supply stops are not specified with fixture. Valves are specified in Division 22 Section "General-Duty Valves for Plumbing Piping."

I. Install trap and tubular waste piping on drain outlet of each fixture to be directly connected to sanitary drainage system.

J. Install tubular waste piping on drain outlet of each fixture to be indirectly connected to drainage system.

K. Install flushometer valves for accessible water closets and urinals with handle mounted on wide side of compartment. Install other actuators in locations that are easy for people with disabilities to reach.

L. Install toilet seats on water closets.

M. Install faucet-spout fittings with specified flow rates and patterns in faucet spouts if faucets are not available with required rates and patterns. Include adapters if required.

N. Install water-supply flow-control fittings with specified flow rates in fixture supplies at stop valves.

O. Install faucet flow-control fittings with specified flow rates and patterns in faucet spouts if faucets are not available with required rates and patterns. Include adapters if required.

P. Install shower flow-control fittings with specified maximum flow rates in shower arms.

Q. Install traps on fixture outlets.

R. Exception: Omit trap on fixtures with integral traps.

S. Exception: Omit trap on indirect wastes, unless otherwise indicated.

T. Install escutcheons at piping wall ceiling penetrations in exposed, finished locations and within cabinets and millwork. Use deep-pattern escutcheons if required to conceal protruding fittings. Escutcheons are specified in Division 22 Section "Common Work Results for Plumbing."

U. Seal joints between fixtures and walls, floors, and countertops using sanitary-type, one-part, mildew-resistant silicone sealant. Match sealant color to fixture color. Sealants are specified in Division 07 Section "Joint Sealants."

V. All plumbing fixtures are to be mounted at the height specified on the Architectural drawings.

3.03 CONNECTIONS

A. Piping installation requirements are specified in other Division 22 Sections. Drawings indicate general arrangement of piping, fittings, and specialties.

B. Connect fixtures with water supplies, stops, and risers, and with traps, soil, waste, and vent piping. Use size fittings required to match fixtures.

C. Ground equipment according to Division 26 Section "Grounding and Bonding for Electrical Systems."

D. Connect wiring according to Division 26 Section "Low-Voltage Electrical Power Conductors and Cables."

3.04 FIELD QUALITY CONTROL

A. Verify that installed plumbing fixtures are categories and types specified for locations where installed.

B. Check that plumbing fixtures are complete with trim, faucets, fittings, and other specified components.

C. Inspect installed plumbing fixtures for damage. Replace damaged fixtures and components.

D. Test installed fixtures after water systems are pressurized for proper operation. Replace malfunctioning fixtures and components, then retest. Repeat procedure until units operate properly.

E. Install fresh batteries in sensor-operated mechanisms.

3.05 ADJUSTING

A. Operate and adjust faucets and controls. Replace damaged and malfunctioning fixtures, fittings, and controls.

B. Adjust water pressure at faucets and flushometer valves to produce proper flow and stream.

C. Replace washers and seals of leaking and dripping faucets and stops.

D. Install fresh batteries in sensor-operated mechanisms.

3.06 CLEANING

A. Clean fixtures, faucets, and other fittings with manufacturers' recommended cleaning methods and materials. Do the following:

1. Remove faucet spouts and strainers, remove sediment and debris, and reinstall strainers and spouts.
2. Remove sediment and debris from drains.

B. After completing installation of exposed, factory-finished fixtures, faucets, and fittings, inspect exposed finishes and repair damaged finishes.

3.07 PROTECTION

A. Provide protective covering for installed fixtures and fittings.

B. Do not allow use of plumbing fixtures for temporary facilities unless approved in writing by Owner.

END OF SECTION 22 4000

SECTION 230000 - GENERAL MECHANICAL REQUIREMENTS

PART I - 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 work of this section.

Sections of other Divisions which relate to mechanical work apply to the work of this section. See various Sections on sitework, underfloor work, structural work, finish materials, etc.

B. Related Sections: Refer to “Electrical Requirements for Mechanical Equipment” Section in Division 23 for basic electrical requirements for all mechanical equipment. Special and specific electrical requirements are specified within each respective equipment specification section.

1.2 SUMMARY: This Section specifies the basic requirements for mechanical installations and includes requirements common to more than one section of Division 23. It expands and supplements the requirements of Division 01.

This Division does not define, nor is it limited by, trade jurisdictions. All work described herein is a part of the General Contract and is required of the Contractor regardless.

1.3 DESCRIPTION OF PROJECT: The mechanical work described in these mechanical specifications is for the Logan, UT Seminary Building project located in Logan, Utah. Design weather conditions are: 95^{o} db, 62^{o} wb, and winter -5^{o}F. Altitude readings, unless otherwise noted, are for an elevation of 4,500 feet above sea level. Make adjustment to manufacturer's performance data as needed.

1.4 CODES AND PERMITS, AUTHORITIES HAVING JURISDICTION:

A. Perform the mechanical work in strict accordance with the applicable provisions of the various codes ordinances and adoptions pertaining to the project location in effect on the date of invitation for bids. Provide all materials and labor necessary to comply with rules, regulations and ordinances. Where the drawings and/or specifications indicate materials or construction in excess of code requirements, the drawings and/or specifications govern.

B. Hold and save the Owner and Architect/Engineer free and harmless from liability of any nature or kind arising from failure to comply with codes and ordinances.

C. Secure all permits necessary for the prosecution of the work under this contract. Owner to pay all fees including connection fees related to utility hookups.

D. Reference Standards:

American Welding Society
International Mechanical Code/State Code
International Building Code/State Code

SMACNA Duct Design Standards
Local/State Plumbing Code
Locally enforced NFPA Codes
Local Fuel Utility Regulations
Local Power Utility Regulations
American Gas Association
ASME Codes for Pressure Vessels and Piping
ANSI B31.1 Piping

E. Final inspection by the Architect/Engineer will not be made nor Certificate of Substantial Completion issued until certificates of acceptability from the Authorities having jurisdiction are delivered.

1.5 DEFINITION OF PLANS AND SPECIFICATIONS: The mechanical drawings at reduced scale show the general arrangement of piping, ductwork, equipment, etc., and shall be followed as closely as the actual building construction and the work of other trades will permit. The architectural and structural drawings shall be considered as part of the work insofar as these drawings furnish the Contractor with information relating to design and construction of the building. Architectural drawings shall take precedence over mechanical drawings. Request clarification and participate in resolution in the event of conflict.

Because of the small scale of the mechanical drawings, it is not possible to indicate all offsets, fittings and accessories which may be required. Investigate the structural and finish conditions affecting the work and arrange the work accordingly, providing such extensions, fittings, valves and accessories to meet the conditions as may be required. Some small scale work is not shown such as control conduit and piping, incidental piping, specialties. Provide as directed by note or specification.

Examine the actual construction site prior to bidding and obtain an understanding of the conditions under which the work will be performed. No allowances will be made for failure to make such examination.

During construction, verify the dimensions governing the mechanical work at the building. No extra compensation shall be claimed or allowed because of differences between actual dimensions and those indicated on the drawings. Examine adjoining work on which mechanical work is dependent for perfect efficiency, and report any work of other trades which must be corrected. No waiver of responsibility for defective work shall be claimed nor allowed due to failure to report unfavorable conditions affecting the mechanical work.

1.6 ROUGH-IN:

A. Verify final locations for rough-ins with field measurements and with the requirements of the actual equipment to be connected.

B. Refer to equipment specifications in Divisions 2 through 26 for rough-in requirements.

1.7 MECHANICAL INSTALLATIONS:

A. Coordinate mechanical equipment and materials installation with other building components.

B. Verify all dimensions by field measurements.

C. Arrange for chases, slots, and openings in other building components to allow for mechanical installations.

D. 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.

E. Sequence, coordinate, and integrate installations of mechanical materials and equipment for efficient flow of the Work. Give particular attention to large equipment requiring positioning prior to closing-in the building.

F. Coordinate the cutting and patching of building components to accommodate installation of mechanical equipment and materials.

G. Where mounting heights are not detailed or dimensioned, install mechanical services and overhead equipment to provide the maximum headroom possible.

H. Install mechanical equipment to facilitate maintenance and repair or replacement of equipment components. As much as practical, connect equipment for ease of disconnecting, with minimum of interference with other installations.

I. Coordinate the installation of mechanical materials and equipment above ceilings with suspension systems, light fixtures, existing structures and other installations.

J. Coordinate connection of mechanical systems with exterior underground and overhead utilities and services. Comply with requirements of governing regulations, franchised service companies, and controlling agencies. Provide required connection for each service.

K. Where mechanical work penetrates other trade work such as gypboard walls, etc., penetration shall be neatly cut and walls shall be filled and patched.

1.8 ACCESSIBILITY:

A. Install equipment and materials to provide required access for servicing and maintenance. Coordinate the final location of concealed equipment and devices requiring access with final location of required access panels and doors. Allow ample space for removal of all parts that require replacement or servicing.

B. Extend all grease fittings to an accessible location.

C. Establish required clearance to all installation features involving operation and maintenance. Respect manufacturers recommendations for access and clearance.

D. Access Doors - General: All items of mechanical equipment which may require adjustment, maintenance, replacement or which control a system function shall be made readily accessible to personnel operating the building.

1. Provide access doors in all ductwork or plenums as required to maintain fire dampers, fire smoke dampers, equipment, controls or other elements of the system. Doors shall conform to SMACNA standards unless otherwise detailed or specified. Refer to 233300 for sizes.

2. Provide access doors in floors, walls, ceiling and partitions to valves, cleanouts,

chases, dampers, etc., and to access doors in ductwork requiring the same. Access doors shall be all-steel construction equivalent to "Milcor" by Inland Ryerson in a style approved by the Owner's Representative. Doors shall be 24" x 24" minimum, or larger as needed, with screwdriver latches.

1.9 CHANGE ORDERS: See General Conditions.

1.10 ALTERNATIVE CONSTRUCTION/SUBSTITUTION: These documents outline a way in which the Owner may be delivered a functional and reliable facility. Drawings and specifications describe reasonable engineering practice for the Contractor to follow.

Coordination between trades may result in periodic needs to adjust the installation from that indicated, but in no case shall the intended function be compromised.

The Contractor may perceive some work methods which differ from those specified which could save time and effort. These may be presented to the Architect with a breakdown of possible cost savings for review. Implement only with authorization.

Materials substitutions will generally be covered in a review process prior to bidding. After bidding, substitutions shall be proposed only on the basis of definitive cost accounting and implemented only with authorization.

1.11 CUTTING AND PATCHING:

A. Lay out the project where new work is involved ahead of time, providing sleeves and blockouts, and have work specifically formed, poured and framed to accommodate mechanical installations. Cut and patch only as needed.

B. Refer to the Division 1 Section: CUTTING AND PATCHING for general requirements for cutting and patching.

C. Refer to Division 26 Section: BASIC ELECTRICAL REQUIREMENTS for requirements for cutting and patching electrical equipment, components, and materials.

D. Do not endanger or damage installed Work through procedures and processes of cutting and patching.

E. Arrange for repairs required to restore other and any work damaged as a result of mechanical installations.

F. No additional compensation will be authorized for cutting and patching Work that is necessitated by ill-timed, defective, or non-conforming installations.

G. Perform cutting, fitting, and patching of mechanical equipment and materials required to:

1. Uncover Work to provide for installation of ill-timed Work;

2. Remove and replace defective Work;

3. Remove and replace Work not conforming to requirements of the Contract Documents;

4. Remove samples of installed Work as specified for testing:

5. Install equipment and materials in existing structures.

H. Upon written instructions from the Architect/Engineer, uncover and restore Work to provide for Architect/Engineer observation of concealed Work.

I. Cut, remove and legally dispose of selected mechanical equipment, components, and materials as indicated, including, but not limited to removal of mechanical piping and other mechanical items made obsolete by the new Work.

J. Protect the structure, furnishings, finishes, and adjacent materials not indicated or scheduled to be removed.

K. Provide and maintain temporary partitions or dust barriers adequate to prevent the spread of dust and dirt to adjacent areas.

1.12 SUBMITTALS: Submittal of shop drawings, product data, and samples will be accepted only from the Contractor to the Architect. Data submitted from subcontractors and material suppliers directly to the Architect/Engineer will not be processed. Document each transmittal and sign and stamp the submittal indicating that it has been reviewed and is in compliance with the criteria of the project, any exceptions being clearly noted.

A. Shop Drawings: As soon as possible after the contract is awarded, submit to the Architect, one (1) printed copy and 1 digital copy in PDF format of the descriptive literature covering all equipment and materials to be used in the installation of mechanical systems for this project. Written confirmation of acceptable review by the Owner's Representative shall be obtained before ordering, purchasing, acquiring or installing any such equipment or materials for the project. Exceptions allowed, in general submit items of a related nature under a common cover to facilitate and coordinate review.

Prepare the submittals in an orderly manner after the order of this specification, contained in a three-ring looseleaf binder(s) with identification tabs for each item or group of related items. Submitted literature shall clearly indicate performance, quality, utility requirements, dimensions of size, connection points and other information pertinent to effective review.

Equipment must fit into the available space with allowance for operation, maintenance, etc. The Contractor shall take full responsibility for space and utility requirements for equipment installed.

Factory-wired equipment shall include shop drawings of all internal wiring to be furnished with unit.

Review of the Architect/Engineer is for general conformance of the submitted equipment of the project specification; in no way does such approval relieve Contractor of his obligation to furnish equipment and materials that comply in detail to the specification, nor does it relieve the Contractor of his obligation to determine actual field dimensions and conditions which may affect his work.

B. Record Drawings: During the course of construction, maintain a set of drawings,

specifications, change orders, shop drawings, addenda, etc., for reference and upon which all deviations from the original layout are recorded. Turn these marked-up documents over to the Architect/Engineer at the conclusion of the work so that the original tracings can be revised. If the Contractor fails to mark up the prints, reimburse the Architect/Engineer for time required to do so.

1.13 OPERATION AND MAINTENANCE TRAINING:

A. Instruction Of Owner's Personnel: At a time prior to Owner making use of a device or system, and in general after testing and balance work for a building or major system is complete, prepare, schedule and conduct a series of training sessions for Owner's operating and supervisory personnel. Instructions shall cover each device and system with emphasis on understanding of the purpose and function, the maintenance requirements and the proper adjustment and operating technique.

B. Instruct building operating staff in operation and maintenance of mechanical systems utilizing Operation and Maintenance Manual when so doing.

C. Minimum instruction periods shall be as follows:

1. Mechanical - eight hours, total.

2. Temperature Control - eight hours, total. Programming help as needed.

D. Initial instruction periods shall occur after pre-final inspection when systems are properly working and before final payment is made. Schedule subsequent visits with the Owner’s Building Operation Personnel throughout the first year.

E. None of these instructional periods shall overlap another.

F. Vendors for each piece of equipment controls, etc., shall participate along with the Contractor(s).

1.14 GUARANTEE/WARRANTY: The following guarantee is a part of this specification and is binding on the part of the Contractor and his assigns:

"Contractor guarantees that this installation is in accordance with the terms of the Contract and is free from mechanical defects. He agrees to replace or repair, to the satisfaction of the Owner's Representative, any part of this installation which may fail or be determined unacceptable within a period of one (1) year after final acceptance. See also the General Conditions of these specifications. Failed equipment in the repair or replacement shall be guaranteed for one full year from the date of recommission."

Compile and assemble the warranties required by Division 23 into a separated set of vinyl covered, insert sheets, tabulated and indexed for each reference, included in the O & M Manual.

Provide complete warranty information for each item to include product or equipment to include date of beginning of warranty or bond; duration of warranty or bond; and names, addresses, and telephone numbers and procedures for filing a claim and obtaining warranty services.

Mechanical systems and equipment shall not be considered for substantial completion and initiation of warranty until they have performed in service continuously without malfunction for at least thirty (30) working days.

1.15 TESTS AND CERTIFICATIONS: Make all tests required by code or specification in the presence of a representative of the Owner, with tests recorded and certified by the Contractor and Representative. Involve local authorities where required.

1.16 PERMITS, FEES, LICENSES: Refer to General Conditions. See Paragraph 1.4.

1.17 CEILING SPACE COORDINATION: Carefully coordinate ceiling cavity space with all trades; however, installation of mechanical equipment within the ceiling cavity space allocation, in the event of conflict, shall be in the following order: plumbing waste lines; supply, return and exhaust ductwork; domestic hot and cold water; fire protection; control conduit. Respect clearances required for lights, electrical conduits, protected structure, etc. All spaces above any and all ceilings shall be defined and considered as return air plenum space.

1.18 MECHANICAL COORDINATION DRAWINGS: For the mechanical rooms, high temperature water converter room, fan rooms, congested areas, or areas of great detail, prepare and submit a set of coordination drawings showing major elements, components and systems of mechanical equipment and materials in relationship with other building components (structure, fire sprinkler, electrical, etc.). Prepare drawings to an accurate scale of 1/4" - 1-0" or larger. Indicate the locations of all equipment and materials, including clearances for installing and maintaining equipment, servicing and maintaining equipment, valve stem movement, and similar requirements. Indicate movement and positioning of large equipment into the building during construction.

Prepare floor plans, reflected ceiling plans, elevations, sections and details to conclusively coordinate and integrate all installations. Indicate locations where space is limited, and where sequencing and coordination of installations are of importance to the efficient flow of the work, including (but not necessarily limited to) the following:

A. Mechanical equipment rooms:

1. Rooftop Unit
2. Specialty systems
3. Electrical installations
4. Related structure

B. Work in pipe spaces, chases and trenches.

C. Exterior wall penetrations.

D. Ceiling and floor plenums which contain piping, ductwork, or equipment in congested arrangement. To include structure, ductwork, piping, fire protection, large electrical conduit, recessed lights, etc.

E. Installations in mechanical riser shafts, at typical sections and crucial offsets and junctures.

F. Pipe expansion loops.

G. Numbered valve location diagrams.

H. Exterior underground lines in common excavation.

I. Manifold piping for multiple equipment units.

J. General floor plan layouts with ductwork, piping, lighting, structure, etc.

K. Use drawings to coordinate all affected trades. Do not work without coordinated drawings.

PART II - GENERAL MECHANICAL MATERIALS AND METHODS

2.1 QUALITY OF MATERIALS AND EQUIPMENT:

A. All equipment and materials shall be new, and shall be the standard products of manufacturers regularly engaged in the production of plumbing, heating, ventilating and air conditioning equipment, and shall be the manufacturer's latest design. Specific equipment shown in schedules on drawings and specified herein is to be the basis for the Contractor's bid. Provisions for substitute equipment are outlined in the General Conditions. All materials shall be produced by manufacturing plants located in the United States of America.

B. Furnish and install all major items of equipment specified in the equipment schedules on the drawings complete with all accessories normally supplied with catalog items listed, and all other accessories necessary for a complete and satisfactory installation.

2.2 PROTECTION OF MATERIALS AND EQUIPMENT:

A. Close pipe and duct openings with caps or plugs to prevent lodgement of dirt or trash during the course of installation. Cover equipment tightly and protect against dirt, water and chemical or mechanical injury. Plumbing fixtures intended for the final installation shall not be used by the construction forces. At the completion of the work, clean fixtures, equipment and materials and polish thoroughly and deliver in a factory dock condition for the Owner's acceptance. Make damage and defects developing before acceptance of the work good at Contractor's expense.

B. Do not make temporary use of project equipment, new or existing, during construction without the written consent of the owner. Systems shall not be used for temporary heat.

2.3 QUALIFICATIONS OF WORKMEN:

A. All mechanics shall be capable journeymen, skilled in the work assigned to them. Apprentices may be used with appropriate direction.

B. Employ no unskilled persons in the work which he is given to do; execute all work in a skillful and workmanlike manner. All persons employed upon this work shall be competent, faithful, orderly and satisfactory to the Owner. Should the Owner's Representative deem anyone employed on the work incompetent or unfit for his duties, and so certify, Contractor shall dismiss him and he shall not be again employed upon the work without permission of the Owner's Representative.

C. All welders involved in welding of pressure piping systems shall be certified in accordance with Section IX of the ASME Boiler and Pressure Vessel Code. Written verification of successful test completion shall be submitted to Architect prior to

initiating work.

2.4 FOREMAN: Dedicate and designate a full-time general mechanical foreman to the Owner's Representative to be consistently available on site during the life of the project for consultation. Do not replace this individual without prior approval from the Owner's Representative.

2.5 USE OF COMMON VENDORS: Regardless of subcontract delegations, coordinate purchasing between trades so that equipment and materials of similar nature come from a single vendor, i.e., all package HVAC terminal units shall be common source. Valves, terminal boxes, speed drives, etc., the same. Do not burden the Owner with multiple brands of similar equipment unless so directed.

2.6 ROOF/WALL/FLOOR PENETRATIONS - FLASHINGS:

A. Install sleeves through the floor into “dry rooms” flush with the floor, caulked and sealed. Into wet rooms, extend piping to create 1" dam. Use Schedule 40 galvanized steel pipe for all pipe sleeves.

B. Let pipe sleeves allow for movement of the pipe due to expansion and contraction, yet to include seismic restraint.

C. Refer to Section “FIRE STOPPING” for requirements.

D. Flashings:

1. Flash all pipes penetrating the roof. Provide required flashing components.

2. Clamp roof drains to roof membrane, follow manufacturer's directions.

3. Flash and counterflash other piping penetrating the roof. See drawings or Architect/Engineer for additional detail.

2.7 EXCAVATING AND BACKFILLING (GENERAL):

A. Provide all excavation, trenching and backfilling for Division 23 underground piping work. Excavation and backfilling shall comply with applicable paragraphs of Division 2. Tamp bottoms of trenches hard and, for soil and waste piping, grade to secure uniform fall of 1/4" per foot, or as noted. Excavate bell holes for hub and spigot pipes so that pipe rests on solid ground for its entire length. Lay sewer and water pipe in separate trenches, except where otherwise noted, as detailed.

B. After work has been tested, inspected and approved by the Owner's Representative and/or State/Local Inspector, and prior to backfilling, clean the excavation of all rubbish, and clean backfill materials free of trash. Place backfill in horizontal layers not exceeding 12" in thickness, properly moistened. Mechanically compact each layer with suitable equipment to a dry density of not less than 95 percent as determined by the Modified AASHO Test T-18O. See Division 2 for additional requirements.

1. Provide adequate shoring to safeguard workers from cave-ins for all excavations.
   a. In areas where General Contractor has finish grade work to do, Mechanical Contractor shall backfill and compact to 8" below

finish grade. Where no finish surface work is to be done, Mechanical Contractor shall backfill and compact to and match adjacent undisturbed surface with allowance for settling, etc.

2. Protect from damage all existing underground utilities or utility tunnels indicated on the contract drawings (or field located for the Contractor by the Owner prior to excavation operations). Any damage to identified existing utilities or utility tunnels shall be repaired by the Contractor at no cost to the Owner.

2.8 HANGERS AND SUPPORTS (GENERAL):

A. Provide hangers and/or supports for all equipment, piping and ductwork. Primary information is contained in these specifications and on the drawings.

B. Provide hangers and supports to correlate with seismic restraint and vibration isolation.

2.9 MANUFACTURER'S DIRECTIONS: Install all equipment in strict accordance with directions and recommendations furnished by the manufacturer. Where such directions are in conflict with the plans and specifications, report such conflicts to the Architect who shall direct adjustments as deemed necessary and desirable.

2.10 LUBRICATION: Lubricate equipment at startup. Then, provide all lubricants for the operation of all equipment until acceptance by the Owner. The Contractor is held responsible for all damage to equipment and bearings while the equipment is being operated by him consequent to preacceptance operation.

2.11 ELECTRICAL WIRING AND CONTROL:

A. In general, motor starters, related motor starter equipment and power wiring indicated on the electrical drawings and control diagrams are to be furnished and installed under Division 26 of this Specification. Items of electrical control equipment specifically mentioned to be furnished by the Division 23 either in these specifications or on the electrical or mechanical drawings, shall be furnished and mounted by this Contractor and shall be connected under and as required by this Division 23 and Division 26 of these specifications.

B. Refer to the control equipment and wiring shown on the diagrams. Any changes or additions required by specific equipment furnished shall be the complete responsibility of the contractor.

C. Division must be fully coordinated with Division 26 to insure that all required components of the work are included and fully understood. No additional cost shall accrue to the Owner as a result of lack of coordination.

D. Where the detailed electrical work is not shown on the electrical drawings, the Mechanical Contractor shall furnish, install and wire or have prewired all specified and necessary controls for air handling equipment specified for this project. The objective of this paragraph is to make sure a complete operating system is obtained at no additional cost to the Owner for field wiring required related to the equipment.

2.12 FLUSHING AND DRAINING OF SYSTEMS/CLEANING OF PIPING AND DUCTS: Fill, clean and flush and sterilize where appropriate, all water piping systems with water and drain these systems before they are placed in operation. Flushings shall consist of not less than six (6) short, intermittent flushes of five (5) to ten (10) minutes duration. Sample and test each flush for cleanliness. Blow out all other piping systems with compressed air or nitrogen to remove foreign materials that may have been left or deposited in the piping system during its erection. Duct systems shall have all debris removed and fans shall be run to blow out all dust and foreign matter before grilles, outlets or VAV boxes are installed and connected.

Damp wipe all ductwork on installation, cap open ducts, cover fan inlets, vacuum fan plenums and related installation before starting fans. Run fans only with filters in place.

2.13 JOBSITE CLEANUP:

A. Keep site clean during progress of work.

B. At the conclusion of work, clean all installation thoroughly.

1. Leave equipment in a factory dock condition. Correct any damage and touch up or repaint if necessary.

2. Remove all debris from site.

2.14 ARCHITECTURAL ACCESS DOORS:

A. Extent of Work: Provide architectural grade access doors at each point of required access to duct features, piping valves, and specialties, concealed equipment, etc. Coordinate this work with other sections for ceilings, walls, etc.

B. Material: Steel framed doors with heavy duty hinges and latch type locking mechanisms with surface finish configuration to accept, match or correlate with adjacent surface.

1. Product equivalent to Inland-Ryerson “Milcor”, Cesco

2. Size adequate to access point of maintenance, to work on and remove concealed devices and equipment.

C. Installation: Complete, blended into adjacent work.

END OF SECTION 230000

SECTION 230100 - OPERATION AND MAINTENANCE MANUALS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS:

A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division-1 Specifications sections, apply to work of this section.

B. Division-23 General Mechanical Requirements sections apply to work of this section.

1.2 SUMMARY:

A. Furnish two sets of bound operation and maintenance manuals. Manuals shall contain descriptive drawings and data which identify equipment installed at the project and detail the procedures and parts required to maintain and repair the equipment. Copies of approved submittals shall be included for all equipment.

1.3 OPERATION AND MAINTENANCE MANUAL FOR MECHANICAL SYSTEMS:

A. General:

1. The "Operating and Maintenance Manual" is a bound compilation of drawings and data that the owner requires for each building or project. These manuals, complete with drawings and data, shall be furnished to the Owner.

2. The mechanical contractor has overall responsibility to obtain the necessary data and compile the data as set forth in this specification, including items or equipment purchased by the Owner and delivered to the contractor for installation.

3. The number of binders (or "volumes") required will depend on the amount of information to be catalogued. Total "sets" see paragraph 1.2A.

4. Make all information legible and sufficiently marked to indicate the exact size, model, type, etc., of equipment furnished and installed.

B. Purpose: The Operating and Maintenance Manual is prepared to provide a ready reference to all important pieces of mechanical and electrical equipment installed on the project. It is also to provide the necessary operating and maintenance data for use by service personnel. It is also to provide information required for checking equipment performance or for planning of plant expansion or redesign.

PART II - MATERIALS AND METHODS

2.1 PAGE SIZE: All pages shall be standard 8-1/2 x 11 inches size or approximate multiples (preferably 16 x 11 inches) folded to 8-1/2 x 11 inch.

2.2 DRAWINGS: All drawings larger than 8-1/2" x 11" shall be folded and inserted in individual 8-1/2" x 11" manilla pockets, which shall have standard three-ring side punching for insertion in the binders. The equipment name, drawing description and number shall be written on the face of each manilla pocket.

2.3 BINDERS: Binders shall be 8-1/2 x 11 inch, 3 ring ridged type “D” with clear plastic cover and backbone for slip in title information 2" to 3" rings as required for the project. The number of binders, however, shall be based on not filling them beyond 2-1/2" thickness.

A. Place the following information on 8-1/2” x 11” white paper to slip into plastic covers on front and backbone:

1. "Operation and Maintenance Manual".

2. Project Name (and volume number if more than one volume).

3. Project Number.

4. Architect's name.

5. Engineer's name.

6. General Contractor's name.

7. Mechanical Contractor's name.

8. Items 6 through 8 need not be printed on the backbone.

2.4 CONTENTS AND INDEXING:

A. Manuals shall contain descriptions of the building systems in sufficient detail to adequately indicate the type of systems installed and the basic details of their operation.

B. All purchased equipment data shall be used to designate the sections. Within each section additional indexing of component parts may be required.

C. Operation and Maintenance Manuals shall contain to the fullest extent all possible information pertinent to the equipment. The arrangement and type of information to be filed shall be as follows:

1. Copy of purchase order change (if any).

2. Outline drawings, special construction details, “as built” electrical wiring and control diagrams for all major and supplementary systems.

3. Manufacturer’s test or calculated performance data and certified test curves.

4. Installation, operating, and maintenance instructions, including a complete parts list and sectional drawing with parts identification numbers. Mark with model, size and plan number.

5. Manufacturer’s brochure marked to indicate exact equipment purchased. Brochures on component parts supplied by a manufacturer with his equipment, but not manufactured directly by him, shall also be included.

6. The serial numbers of each item of equipment installed are to be listed with the model numbers and plan symbols.

7. Include a Table of Contents. The contents shall be divided with tabbed index

dividers into the following suggested parts:

a. Part I Building and System Descriptions
b. Part II Purchased Equipment Data
c. Part III Test Reports and Valve Charts
d. Part IV Start-Up and Operation
e. Part V Preventative Maintenance Recommendations

8. A copy of the approved submittals for each piece of equipment.

9. A copy of all testing, adjusting and balancing reports.

10. Wiring diagrams, marked with model and size and plan symbol.

11. The index shall contain the name and address of the manufacturer and, if different, where replacement and repair parts may be obtained.

END OF SECTION 230100

SECTION 230513 - MOTORS, DRIVES AND ELECTRICAL REQUIREMENTS FOR MECHANICAL WORK

PART I - 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 work of this section.

B. Related Sections: Separate electrical components and materials required for field installation and electrical connections are specified in Division 26.

1.2 SUMMARY:

A. This section specifies the basic requirements for motors and drives furnished by this Division and for electrical components which are an integral part of packaged mechanical equipment. Package components include, but are not limited to factory installed motors, starters, and disconnect switches, etc.

B. Specific electrical requirements (i.e. horsepower and electrical characteristics) for mechanical equipment are noted within these documents.

1.3 QUALITY ASSURANCE:

A. Provide electrical components and materials which are UL labeled.

B. Provide variable speed drives which conform to the latest standard of the following:

1. IEEE - Institute of Electrical and Electronic Engineers.

2. NEC - National Electrical Code.

3. NEMA - National Electrical Manufacturers Association.

4. Provide complete packaged unit(s) which are listed and carry the label of at least one of the following:

   a. UL - Underwriters Laboratory
   b. ETL - ETL Testing Laboratories, Inc.
   c. CSA - Canadian Standards Association

1.4 SUBMITTALS:

A. Submit complete product and application information for variable speed drives as follows:

1. Provide multiple sets of drawings of system (VFD) being supplied, in strict compliance with the specifications. Include, as a minimum:

a. General arrangement of each unit showing size and incoming and outgoing conduit locations.

b. Schematic.

c. Connection diagram, sufficient to install drive system.

2. Provide each unit with four owner/maintenance manuals which shall include:

a. Vendor information of equipment being supplied.

b. Connection information.

c. Start up procedure.

d. Fault reset instruction.

e. Wiring diagrams (power and control).

f. Parts list.

g. Test results.

h. Harmonic voltage distortion on line with unit off.

i. Harmonic voltage distortion with unit on line.

B. Submit product data for motors, belts, drives, starters, and other electrical components with submittal data required for the equipment for which it serves, as required by the individual equipment specification sections. Verify project electrical characteristics with submittal. Confirm suitability for altitude, maintaining full nameplate rating plus service factor. Include this data in maintenance manual in accordance with Section "Operation and Maintenance Manuals".

1.5 REFERENCES:

A. NEMA Standards MG 1: Motors and Generators.

B. NEMA Standards ICS 2: Industrial Control Devices, Controllers, and Assemblies.

C. NEMA Standards 250: Enclosures for Electrical Equipment.

D. NEMA Standards KS 1: Enclosed Switches.

E. Comply with National Electrical Code (NFPA 70).

1.6 WARRANTY:

A. General: For variable frequency drives. Furnish a written warranty consisting of the following:

1. Warranty parts and labor for five years after substantial completion.

PART II - PRODUCTS

2.1 MOTORS:

A. The following are basic requirements for simple or common motors. For special motors, more detailed and specific requirements are specified in the individual equipment specifications.

1. Motor torque characteristics shall be sufficient to satisfactorily accelerate the driven loads to operating speed within the time limits of the motor rating and of the starting equipment settings.
2. Motor sizes shall be large enough so that the driven load will not require the motor to operate in the service factor range, or above 3300 feet elevation, will not cause the motor to operate above the manufacturer's motor rating for that altitude. Coordinate this requirement with the conductor and starting equipment sizing for each motor.
3. Except for submersible pumps, motors shall be air cooled.
4. Typically provide fractional horsepower, single speed, single phase motors (1/2 horsepower and less) of the permanent split capacitor type. (PSC) This requirement generally avoids motors of the shaded pole type.
5. For motors 3/4 horsepower and larger, typically furnish polyphase squirrel cage type units.
6. Furnish two-speed motors with 2 separate polyphase windings. Confirm 2-speed, 2-winding starter requirements with Division 26.
7. Temperature Rating: at a minimum, rate motors and motor drives for operation 40˚C environment with maximum 90˚C temperature rise for continuous duty at full load (Class H Insulation for altitude, Class B leads allowed).
8. Starting Capability: Frequency of starts as indicated by automatic control system, with not less than 6 evenly timed spaced starts per hour for manually or automatically controlled motors.
9. Service Factor: For sea level to 3300 feet elevation, 1.15 for poly-phase motors and 1.35 for single phase motors, 1.0 for TEFC motors. Note that above 3300 feet elevation, motor ratings typically de-rate the service factor from 1.15 to 1.0.
10. Provide pump motors with an end shield on the motor shaft and with ventilation openings beneath the motor.
11. Motor Construction: NEMA Standard MG 1, general Purpose, continuous duty, design "B", except "C" where required for high starting torque.
12. Frames: NEMA Standard No. 48 or 54; T-frame, use driven equipment manufacturer's standards to suit specific application.
13. Bearings:
    a. Ball or roller bearings with inner and outer shaft seals; for fractional horsepower, light intermittent/occasional duty motors, sleeve type bearings will be acceptable.
    b. Regreasable with zerk type and relief plug fittings, except permanently sealed where motor is normally inaccessible for regular maintenance. Lubricate motors at startup and then as recommended by manufacturer. Where sealed bearings are used, provide bearings with a nominal L10 –

100,000 hour life expectancy.

c. Design bearings to resist thrust loading where belt drives or other drives produce lateral or axial thrust on the motor;
d. Motors for use with variable frequency drives shall be inverter duty rated, premium efficiency. Motor bearings shall be electrically isolated from motor housing. Coordinate motor with Variable Frequency Drive supplier and equipment.

14. Motor Enclosure Type:
    a. Open drip-proof (ODP) motors for indoor use where they can be satisfactorily housed or remotely located during operation.
    b. Guarded drip-proof motors where exposed to contact by employees or building occupants.
    c. Weather protected type I for outdoor use, Type II where not housed.
    d. Cooling Tower duty rated for cooling tower applications.
    e. Totally enclosed, fan cooled (TEFC) for wet or dirty environments.
    f. Explosion Proof (EP) for hazardous rated environments.
15. Overload Protection: built-in thermal overload protection and, where indicated for large motors, internal sensing device suitable for signaling and stopping motor at starter.
16. Noise Rating: Provide motors which are "Quiet," within the sound power levels described by NEMA MGI-12.49, and which are commercially dynamically balanced at the factory.
17. Efficiency: Typically provide "Premium Energy Efficient" motors with a minimum efficiency as scheduled in accordance with IEEE Standard 112, test method B. If an efficiency is not specified by the standard, motors shall have a higher efficiency than “average standard industry motors", in accordance with IEEE Standard 112. Motors used with Variable Frequency Drives shall be compatible and designed for use with Variable Frequency Drives and “Inverter Duty” rated. An “explosion proof” motor for classified areas, scheduled for use with VFD’s, shall be listed for inverter duty applications.
18. Nameplate: indicate the full identification of manufacture: model, rating, characteristics, construction, special features and similar information.
19. Motors fitted with V-Belt or other tensioned drives shall have a cast iron or welded steel baseplate, with guided slide rails and adjustable screw tensioners, and rubber in shear bolt mountings.
20. Motor drives and couplings shall utilize shaft bushings to accommodate various shaft and drive diameters. Couplings shall be of the Browning Ever-Flex or Dodge “Para-flex” type, not a toothed gear with rubber insert (jaw) type.
21. Acceptable Manufacturers (subject to review on an individual application basis.)

a.	Baldor	e.	Reliance
b.	General Electric	f.	Siemens
c.	Lincoln	g.	Toshiba
d.	Magnetek	h.	U.S. Motors

2.2 MOTOR DRIVES:

A. Provide fan/motor drives with cast steel sheaves and V-belt sets of fabric and rubber construction by Browning, Dodge, Woods. Match multiple belts and adjust to drive the

apparatus properly and to prevent slippage and undue wear in starting. Design drives for 150 percent or more of the specified motor nameplate rating. Bush all drives. Belts shall be A, B or C section belts. Narrow gauge belts are not acceptable. Adjust drives or replace sheaves as needed to obtain required capacities.

B. Provide flexible coupled drives for pumps by Browning, Dodge or Woods.

C. Provide a galvanized iron metal guard for each V-belt drive, coupled drive or rotating shaft constructed around an angle iron frame, securely bolted to the floor or apparatus. Design the guard to completely enclose drives and pulleys and be constructed to comply with all safety requirements. Provide hinged access doors not less than 6" x 6" for access to motor and fan shaft for test purposes. For double inlet fans, construct the belt guard cover of 1/2" mesh expanded metal, arranged as not to restrict the air flow into the fan inlet.

END OF SECTION 230513

SECTION 230529 - MECHANICAL SUPPORTING DEVICES

PART I - 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 Division-23 Mechanical Supporting Devices section and is part of each Division-23 section making reference to supports and anchors specified herein.

C. Division-23 General Mechanical Requirements apply to work of this section.

1.2 SUMMARY:

A. Extent of supports and anchors required by this section is indicated on drawings and/or specified in other Division-23 sections.

B. Types of supports and anchors specified in this section include the following:

1. Hanger-Rod Attachments.
2. Building Attachments and In-Beds.
3. Miscellaneous Materials.
4. Anchors.
5. Equipment Supports.

C. Supports and anchors furnished as part of factory-fabricated equipment, are specified as part of equipment assembly in other Division-23 sections.

D. Relate this section to Section 230548 regarding seismic and vibration control.

1.3 QUALITY ASSURANCE:

A. Manufacturer’s Qualifications: Firms regularly engaged in manufacture of supports and anchors, of types and sizes required, whose products have been in satisfactory use in similar service for not less than 5 years.

1.4 SUBMITTALS:

A. Product Data: Submit manufacturer's technical product data, including installation instructions for each type of support and anchor.

B. Shop Drawings:

1. Submit manufacturer's assembly-type shop drawings for each type of support and anchor, indicating dimensions, weights, required clearances, and methods of assembly of components.

C. Maintenance Data: Submit maintenance data and parts list for each type of support and anchor. Include this data, product data, and shop drawings in maintenance manual; in accordance with requirements of General Conditions.

1.5 REFERENCES:

A. Codes and Standards:

1. Code Compliance: Comply with applicable building, mechanical and plumbing codes pertaining to product materials and installation of supports and anchors.

2. UL and FM Compliance: Provide products which are UL-listed and FM approved.

3. MSS Standard Compliance:

a. Provide pipe hangers and supports of which materials, design, and manufacture comply with MSS SP-58.

b. Select and apply pipe hangers and supports, complying with MSS SP-69.

c. Fabricate and install pipe hangers and supports, complying with MSS SP-89.

d. Terminology used in this section is defined in MSS SP-90.

PART II - PRODUCTS

2.1 HANGER-ROD ATTACHMENTS:

A. General: Except as otherwise indicated, provide factory- fabricated hanger-rod attachments complying with MSS SP-58, of one of the following MSS types listed, selected by Installer to suit horizontal-piping hangers and building attachments, in accordance with MSS SP-69 and manufacturer's published product information. Use only one type by one manufacturer for each piping service. Select size of hanger-rod attachments to suit hanger rods. Provide copper-plated hanger-rod attachments for copper-piping systems.

B. Steel Turnbuckles: MSS Type 13. (For adjustment up to 6" for heavy loads.)

C. Steel Clevises: MSS Type 14. (For use on high temperature piping installations.)

D. Swivel Turnbuckles: MSS Type 15. (For use with split pipe rings, MSS type 11.)

E. Malleable Iron Sockets: MSS Type 16. (For attaching hanger rod to various types of building attachments.)

2.2 BUILDING ATTACHMENTS AND EMBEDS:

A. General: Except as otherwise indicated, provide factory- fabricated building attachments complying with MSS SP-58, of one of the following MSS types listed, selected by Installer to suit building substrate conditions, in accordance with MSS SP-69 and manufacturer's published product information. Select size of building attachments to suit hanger rods. Provide copper-plated building attachments for copper-piping systems.

B. Concrete Inserts: MSS Type 18. (For upper attachment for suspending pipe hangers from

concrete ceiling.)

C. Top Beam C-Clamp: MSS Type 19. (Use under roof installations with bar joist construction, for attachment to top flange of structural shape.)

D. Side Beam or Channel Clamps: MSS Type 20. (For attachment to bottom flange of beams, channels, or angles.)

E. Center Beam Clamps: MSS Type 21. (For attachment to center of bottom flange of beams.)

F. Welded Beam Attachments: MSS Type 22. (For attachment to bottom of beams where loads are considerable and rod sizes are large.)

G. C-Clamps: MS Type 23. (For attachment to structural shapes.)

H. Top Beam Clamps: MSS Type 25. (For attachment to top of beams when hanger rod is required tangent to edge of flange.)

I. Side Beam Clamps: MSS Type 27. (For attachment to bottom of steel I-beams.)

J. Steel Beam Clamps with Eye Nut: MSS Type 28. (Same as Type 28 with link extensions.)

K. Linked Steel Clamps with Eye Nut: MSS Type 29. (Same as Type 28 with link extensions.)

L. Malleable Beam Clamps: MSS Type 30. (For attachment to structural steel.)

M. Steel Brackets: One of the following for indicated loading:

1. Light Duty: MSS Type 31, to 570 pounds.

2. Medium Duty: MSS Type 32, to 1,500 pounds.

3. Heavy Duty: MSS Type 33, to 3,000 pounds.

N. Side Beam Brackets: MSS Type 34. (For use on sides of steel or wooden beams.)

O. Plate Lugs: MSS Type 57. (For attachment to steel beams where flexibility at the beam is desired.)

P. Horizontal Travelers: MSS Type 58. (For supporting piping systems subject to linear horizontal movements where head room is limited.

Q. Refer to drawings for Unistrut inserts.

2.3 MANUFACTURERS OF HANGERS AND SUPPORTS:

A. Manufacturer: Subject to compliance with requirements, provide hangers and supports of one of the following:

1. Kin-Line, Inc.

2. Fee & Mason Mfg. Co.; Div. Figgie International
3. ITT Grinnel Corp.
4. B-Line
5. Unistrut

2.4 OUTSIDE AREAS: Use galvanized hangers, attachments, rods, nuts, bolts and other accessories for all outside areas.

2.5 MISCELLANEOUS MATERIALS:

A. Metal Framing: Provide products complying with NEMA STD ML 1.

B. Steel Plates, Shapes and Bars: Provide products complying with ASTM A 36.

C. Cement Grout: Portland cement (ASTM C 150, Type I or Type III) and clean uniformly graded, natural sand (ASTM C 404, Size No. 2). Mix at a ratio of 1.0 part cement to 3.0 parts sand, by volume, with minimum amount of water required for placement and hydration. Use Embeco grout for non-shrink applications.

D. Heavy Duty Steel Trapezes: Fabricate from factory built channel (Unistrut) system and use factory fasteners for channel steel shapes, selected for loads required; weld steel in accordance with AWS standards.

E. Pipe Guides: Provide factory-fabricated guides, of cast semi- steel or heavy fabricated steel, consisting of bolted two- section outer cylinder and base with two-section guiding spider bolted tight to pipe. Size guide and spiders to clear pipe and insulation (if any), and cylinder. Provide guides of length recommended by manufacturer to allow indicated travel.

PART III - EXECUTION

3.1 INSPECTION:

A. Examine areas and conditions under which supports and anchors are to be installed. Do not proceed with work until unsatisfactory conditions have been corrected in manner acceptable to Installer.

3.2 PREPARATION:

A. Proceed with installation of hangers, supports and anchors only after required building structural work has been completed in areas where the work is to be installed. Correct inadequacies including (but not limited to) proper placement of inserts, anchors and other building structural attachments.

B. Prior to installation of hangers, supports, anchors and associated work, Installer shall meet at project site with Contractor, installer of each component of associated work, inspection and testing agency representatives (if any), installers of other work requiring coordination with work of this section and Architect/Engineer for purpose of reviewing material selections and procedures to be followed in performing the work in compliance with requirements specified.

3.3 INSTALLATION OF BUILDING ATTACHMENTS:

A. Install building attachments at required locations within concrete or on structural steel for proper piping support. Space attachments within maximum piping span length indicated in MSS SP-69. Install additional concentrated loads, including valves, flanges, guides, strainers, expansion joints, and at changes in direction of piping. Install concrete inserts before concrete is placed; fasten insert securely to forms.

1. Where concrete with compressive strength less than 2500 psi is indicated, install reinforcing bars through the openings at the tops of inserts.

3.4 INSTALLATION OF HANGERS AND SUPPORTS:

A. General: Install hangers, supports, clamps and attachments to rigidly support piping properly from building structure; comply with MSS SP-69. Arrange for grouping of parallel runs of horizontal piping to be supported together on trapeze type hangers where possible. Install supports with maximum spacings complying with MSS SP-69. Where piping of various sizes is to be supported together by trapeze hangers, space hangers for smallest pipe size or install intermediate supports for smaller diameter pipe. Do not use wire or perforated metal to support piping, and do not support piping from other piping.

B. Install hangers and supports complete with necessary inserts, bolts, rods, nuts, washers and other accessories. Except as otherwise indicated for exposed continuous pipe runs, install hangers and supports of same type and style as installed for adjacent similar piping.

C. Prevent electrolysis in support of copper tubing by the use of hangers and supports which are copper plated, or by isolating with foam rubber covering or 30 mil insulating tape.

D. Provisions for Movement:

1. Install hangers and supports to allow controlled movement of piping systems and to permit freedom of movement between pipe anchors, and to facilitate action of expansion joints, expansion loops, expansion bends and similar units.

2. Install supports within 2 feet of non-vertical flex connectors.

E. Load Distribution: Install hangers and supports so that piping live and dead loading and stresses from movement will not be transmitted to connected equipment.

F. Pipe Slopes: Install hangers and supports to provide indicated pipe slopes, and so that maximum pipe deflections allowed by ANSI B31 Pressure Piping Codes are not exceeded.

G. Insulated Piping: Do not allow hangers to come in contact with pipe where pipe is specified to be insulated.

H. Clamps: Attach clamps, including spacers (if any), to piping with clamps projecting through insulation; do not exceed pipe stresses allowed by ANSI B31.

I. Shields: Where low-compressive-strength insulation or vapor barriers are indicated on cold or chilled water piping, install galvanized steel protective shields. Install calcium silicate blocks (12" long minimum) at support points.

J. Saddles: Where insulation without vapor barrier is indicated, install protection saddles.

3.5 INSTALLATION OF ANCHORS:

A. Install anchors at proper locations to prevent stresses from exceeding those permitted by ANSI B31, and to prevent transfer for loading and stresses to connected equipment.

B. Fabricate and install anchor by welding steel shapes, plates and bars to piping and to structure. Comply with ANSI B31 and with AWS standards.

C. Where expansion compensators are indicated, install anchors in accordance with expansion unit manufacturer's written instructions, to limit movement of piping and forces to maximums recommended by manufacturer for each unit.

D. Anchor Spacings: Where not otherwise indicated, install anchors at ends of principal pipe-runs, at intermediate points in pipe-runs between expansion loops and bends. Make provisions for preset of anchors as required to accommodate both expansion and contraction of piping.

3.6 EQUIPMENT SUPPORTS:

A. Provide concrete housekeeping bases for all floor mounted equipment furnished as part of the work of Division 23. Size bases to extend a minimum of 4" beyond equipment base in any direction; and 6" above finished floor elevation. Construct of reinforced concrete, roughen floor slab beneath base for bond, and provide steel rod anchors between floor and base. Locate anchor bolts using equipment manufacturer's templates. Chamfer top and edge corners.

B. Provide structural steel stands to support equipment not floor mounted or hung from structure. Construct of structural steel members or steel pipe and fittings. Provide factory-fabricated tank saddles for tanks mounted on steel stands.

3.7 ADJUSTING AND CLEANING:

A. Hanger Adjustment: Adjust hangers so as to distribute loads equally on attachments.

B. Support Adjustment: Provide grout under supports so as to bring piping and equipment to proper level and elevations.

C. Cleaning: Clean factory-finished surfaces. Repair any marred or scratched surfaces with manufacturer's touch-up paint.

END OF SECTION 230529

SECTION 230548 - MECHANICAL SOUND, VIBRATION AND SEISMIC CONTROL

PART I - 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 Division-23 Mechanical Sound, Vibration and Seismic Control section, and is part of each Division-23 section making reference to mechanical sound, vibration and seismic control specified herein.

C. Division-23 General Mechanical Requirements apply to work of this section.

1.2 SUMMARY: Furnish and install complete seismic restraint and vibration control systems for all work installed under Division 23. Including owner furnished contractor installed equipment. Work to be responsive to the intent of the International Building Code, latest adopted edition, for the respective seismic zone. Zone 3, importance factor of 1.

1.3 QUALITY ASSURANCE:

A. Manufacturer's Qualifications: Engage the services of an independent seismic and vibration control subcontractor who has the technology, experience, computer capabilities and manufactured products to prepare the required computations, shop drawings and special devices to meet the minimum requirements described herein. Select from the following:

1. Amber Booth
2. Kinetics
3. Mason

B. The seismic and vibration control subcontractor shall visit the site during construction at a minimum of two specific periods.

1. When equipment is set in place, prior to placement of seismic restraint devices for the purposes of directing the contractor in properly locating and installing the approved devices.

2. At the completion of the project, prior to final mechanical inspection, for the purpose of verifying the correctness of the seismic restraint and vibration isolation device installation and preparing certification of the seismic vibration-isolation work.

C. The seismic subcontractor shall exercise the quality control for this work and shall include, but not be limited to instructions direct to the Mechanical (Division 23) Contractor concerning:

1. Anchoring of all mechanical equipment including owner furnished and contractor installed.

2. Vibration mounting of equipment.

3. Equipment base coordination with restraint requirements.

4. Snubbing of equipment.

5. Bracing and anchoring of ductwork piping and conduit.

6. Provision for expansion and vibration of piping.

7. Concrete and/or steel pads or bases to assure proper mounting of restraints and isolators.

8. Vibration isolation of exhaust fans, relief fans, ventilation fans, and supply air fans.

D. The subcontractor shall be responsible for identifying the need for the size and location of steel sole plates and their attachment to structural steel or concrete.

E. The subcontractor shall certify in writing that he has inspected the installation and that all isolation, anchors and seismic restraint materials are installed correctly and functioning properly. Certification shall be provided after all corrective work has been completed.

1.4 SUBMITTALS:

A. Submittal data is required and shall consist of computations, vibration isolation selection, equipment anchors, anchor bolt sizes, supports, seismic restraints, sole plate data, restraint locations and type of restraints.

B. Submittal data shall identify dimensions, load deflection data, center of gravity, standard connections, manufacturer's recommendations, behavior problems including vibrations, thermal expansion, building expansion joints, etc., associated with equipment, ductwork, piping and conduit.

C. Calculations need not be submitted when restraint devices for piping, conduit and ductwork are proposed in accordance with the SMACNA Guidelines for Seismic Restraints.

D. Selection of isolator anchors and restraints shall be clearly made known along with the basis for selection so that proposed systems can be reviewed.

E. Calculations furnished for anchors, anchor bolts, sole plates and other support steel for restraining devices shall be signed and stamped by an engineer licensed in one of the United States.

1.5 REFERENCES:

A. Codes and Standards: (Latest adopted edition)

1. International Building Code
2. NFPA bulletin 90A,
3. UL Standard 181
4. Guidelines for seismic restraint of Mechanical Systems and Plumbing Piping Systems. Published by the Sheet Metal Industry Fund of Los Angeles, California, and the Plumbing and Piping Industry Council, Inc., Los Angeles, California.

PART II - PRODUCTS:

2.1 MATERIALS - PRODUCTS: Restraint devices shall be especially designed to resist seismic forces in all directions. Use cadmium plated or galvanized brass cables, attachments, nuts, bolts and other accessories in swimming pool area, swimming pool equipment room and swimming pool fan room.

A. Snubbers: Restraint surfaces which engage under seismic motion shall be cushioned with a resilient elastomer neoprene (bridge bearing neoprene) to protect equipment. Restraints shall allow a maximum of 1/4" before engaging and shall not interfere in normal starting or stopping operation. Housing shall allow for visual inspection to determine clearances during system operation. Restraints shall be field adjustable and be positioned for up to 1/4" clearance both horizontally and vertically. Mountings and snubbers are to be manufactured under a Quality Assurance (QA) Program.

B. Snubbers and Isolator Combination Devices: Combination unitized devices may be used where equipment isolation is required. They shall include the requirements listed for snubbers. Isolation portion shall be stable spring type with combination leveling bolt and equipment fastening device. Base plate shall have adequate means for bolting to structure. The spring assembly shall be removable and shall fit within a welded steel enclosure.

C. Piping, Conduit and Duct Restraints: Restraint materials for exposed installation shall be standard fabricated flat steel, angle rod and channel members.

1. Restraint members shall be bolt connected. Cabling materials and methods shall be used only in chases or concealed ceiling spaces.

PART III - EXECUTION

3.1 SEISMIC RESTRAINT GUIDELINE:

A. Guidelines for SMACNA seismic restraints for conduit, piping and ductwork are to serve as the basis for restraint methods. (Exception - no cabling shall be used in the restraint systems except as noted.)

3.2 SEISMIC RESTRAINT-PIPING AND CONDUIT:

A. General: All piping and conduit shall be protected in all planes by restraints, designed to accommodate thermal movement while at the same time restraining seismic motion. Tanks and vessels connected to piping shall be restrained in the same manner as the piping.

B. Locations of the restraints shall include, but not be limited to:

1. At all drops or risers to equipment connections.

2. At all changes in direction of piping and conduit.

3. At all horizontal runs of pipe and conduit to keep it in alignment and prevent sagging with restraints not to exceed the following:

a. Transverse bracing at 40'-0" O.C. maximum.
b. Longitudinal bracing at 80'-0" O.C. maximum.

4. Provide flexibility in joints where pipes pass through building seismic or expansion joints.

5. On both sides of flexible connectors.

C. Exceptions:

1. Conduit under 2-1/2" size and piping under 1-1/2" size need not be additionally seismically restrained except as follows:

a. Brace all piping and conduit 1-1/4" and larger in boiler rooms, mechanical rooms, electrical equipment rooms and refrigeration machinery rooms.

b. Brace all fuel gas and oil piping, medical gas piping and compressed air piping 1" and larger.

2. Seismic bracing may be omitted:

a. When the top of the pipe is suspended 12" or less from the supporting structure member and the pipe or conduit is suspended by an individual hanger.

b. On all piping 3/4" and smaller.

3.3 SEISMIC RESTRAINT INSULATED PIPING: Where piping is designated to be insulated, the points of support shall be protected by a 360° sheet metal shield. Insert insulation shall be of the same thickness as the adjoining pipe insulation. (Pipe Shields, Inc.)

The sheet metal shield wrapped around the insert shall be of the following lengths and gauge thickness.

PIPE SIZE	SHIELD LENGTH	MINIMUM GAUGE
1/2 - 1-1/2"	4"	20
2 - 6"	6"	20
8 - 10"	9"	16
12 - 18"	12"	16
20 and up	18"	16

3.4 SEISMIC RESTRAINT - PIPING AT FIRE-WALL AND FLOOR PENETRATION WHERE WALL IS USED AS A RESTRAINT:

A. Bare Pipe: Encase pipe in minimum 24 gauge sheet metal can sized for one inch spacing between pipe and outer diameter of can. Spacing shall be packed in accordance with fire resistant/retardant materials in accordance with Section: FIRE STOPPING.

B. Insulated Pipe: Encase in adjustable or fixed length cans, minimum 24 gauge, sized for maximum one inch spacing between insulation and outer diameter of can. Insulation shall consist of 360° insert sized to extend a minimum of 1" beyond wall or floor penetration and of the same thickness as the adjoining insulation. Spacing between shield

and can shall be packed in accordance with Section: FIRE STOPPING.

3.5 SEISMIC RESTRAINT - DUCTWORK:

A. Ductwork, four feet square and larger in cross sectional area or 26" diameter and larger shall be protected in all places by restraints. Locations shall include, but not be limited to:

1. At all equipment connections.

2. At all duct turns and duct run ends (transverse bracing).

3. Transverse bracing to occur 30'-0" O.C. maximum. Rectangular ducts 61" and larger in either direction may be braced at 32'-0" O.C.

4. Longitudinal bracing shall occur at 60'-0" O.C. maximum.

B. A group of ducts may be combined in a larger size frame using the overall dimensions with maximum weight for selection of restraint members.

C. No bracing is required if the top of the duct is suspended 12" or less from supporting member and attached at the top of the duct as well as sides and bottom.

3.6 VIBRATION ISOLATION:

A. General: Furnish and install devices to isolate moving equipment from the structure. Review isolation furnished with factory package equipment, require conformance with project criteria.

B. Basic Criteria: Vibration isolation devices which have natural frequencies approximately 1/10 that of the related driving frequency.

C. Equipment to Include:

1. Package air handling units.

D. Field Verify: All required devices and installation.

3.7 VIBRATION ISOLATION - DUCTWORK AND PIPING:

A. Furnish and install devices to isolate all piping and ductwork from other moving equipment. Provide flex connections, spring hangers, grooved joint couplings for pipe, etc., as required.

END OF SECTION 230548

SECTION 230553 - MECHANICAL IDENTIFICATION

PART I - 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. Division-23 Basic Mechanical Materials and Methods section apply to work of this section.

1.2 SUMMARY:

A. Label all plumbing, heating, air conditioning, automatic temperature control equipment (excluding thermostats and relays), and distribution systems. Also label all electrical switches and starters for all mechanical equipment. Label all fire dampers, fire smoke dampers, smoke damper access doors.

PART II - GENERAL MECHANICAL MATERIALS AND METHODS

2.1 EQUIPMENT, PIPE AND DUCT IDENTIFICATION:

A. Equipment:

1. Use the same identification number and name as that shown on the drawings or in these specifications. Make equipment nameplates of black face formica with white engraved lettering 3/16" high or larger, attached securely.

2. Include the following information on equipment nameplates where applicable:

   Identification name.
   Identification number.
   Capacity specified.
   Actual capacity.
   Area or zone served.

   Note operating conditions, including head or static pressure, RPM, motor horsepower at design conditions, area or zone served, name of lubricant, frequency of lubrication.

B. Valve Identification:

1. For all valves, regardless of size, provide brass tags at least 1-1/4" by 3" in size and 0.051 inches thick. Use engraved lettering at least 1/8" high. Identify each valve on the drawing separately, and with valve tags matching the drawing identification.

2. Provide valve tags which include the following minimum information:

   a. Normal Position
   b. Duty

3. Identify tag numbers as follows:

Valve Tags	Duty
1-99	HW
100	CW
200	DWC & DWH
300	FIRE
400	AIR

4. Make a schedule of all tagged valves, include in O & M Manuals.

5. Connect valve tags to valve stems with brass chain.

C. Color code all accessible duct and piping and identify with wording and arrows every 50 feet, at each riser, at each junction, at each access door, and where required to easily identify the medium transported.

D. Identify duct and piping systems by:

1. Lettering color, and

2. Flow Direction Arrow.

3. Identifying lettering shall be painted or stenciled on duct or pipe. Self-adhesive or glue-on type labels are acceptable. Letters shall be 2" high for duct and for 3" or larger piping, 1" high for 1-1/4" to 2-1/2" pipe, and 1/2" high for 1" pipe and smaller.

4. Arrows to indicate direction of flow shall be painted or stenciled on the duct or pipe in the same color as the lettering. The arrow shall point away from the lettering. On duct and 3" or larger piping, the “shaft” of the arrow shall be 2" long and 1" wide. Smaller piping, 2-1/2" or less, shall have arrows with a shaft 1/2" wide and 2" long. Use a double-headed arrow if the flow can be in either direction.

5. Piping and duct shall be identified with the following colors:

6. Label existing high temperature water piping.

Medium in Pipe or Duct	Banding Color	Identifying Lettering	Abbreviation and Lettering Color
Domestic Cold Water	One Green	Domestic Cold Water	DWC Black
Domestic Hot Water	One Yellow Two Green	Domestic Hot Water	DWH Black
Domestic Hot Water Return	One Yellow Two Green	Domestic Hot Water Return	DWHR Black
Fire Protection Water	Red	Fire Protection	Fine Black
Roof Drain	Green	Roof Drain	R. D. Black

Drain		Drain	Black
Building Waste	(Unpainted or Black)	Waste	White
Cold Air Duct		Cold Air Duct	(Unit Served) - Black
Hot Air Duct		Hot Air Duct	(Unit Served) - Black
Return Air Duct		Return Air Duct	(Unit Served) - Black
Exhaust Air Duct		Exhaust Air Duct	(Unit Served) - Black
Supply Duct		Supply Duct	(Unit Served)
Fire, Smoke, Fire/Smoke Damper		Fire, Smoke, Access Doors Fire/Smoke Damper	AD - Red

2.2 PANEL IDENTIFICATION:

A. Provide all panel devices on panel faces with engraved black face formica with white engraved lettering labels.

B. Provide all internal panel components with engraved black face formica labels with white engraved lettering. Fasten label beneath each device.

C. Numerically or alphabetically code all panel wiring and tubing.

END OF SECTION 230553

SECTION 230593 - SYSTEM COMMISSIONING, TESTING AND BALANCING

PART I - GENERAL

1.1 GENERAL CONDITIONS:

A. Work of this section shall be subject to the requirements of the General Conditions of this contract, the General Mechanical Requirements, General Electrical Requirements and other sections where this work shares a responsibility.

B. System commissioning and startup of the mechanical systems shall be the responsibility of the Mechanical Contractor and his subcontractors with the participation of the Electrical Contractor related to electrical work and the General Contractor related to general construction items.

C. Testing and Balancing shall be the responsibility of the Mechanical Contractor under the direction of the General Contractor with the full participation of all of the mechanical and electrical trades employed on the project and shall include the participation of an independent testing and balance contractor to coordinate all elements of the work and to perform special technical services outlined herein.

1.2 SYSTEM COMMISSIONING - EXTENT OF WORK:

A. The work required by this section includes but is not necessarily limited to the following:

1. The pre-startup inspection of all systems and subsequent correction of any incorrect items.

2. The initial first run inspections.

3. System operations inspection.

B. The intent of this work is to provide for proper installation, startup, service and operation of the mechanical systems in preparation for system balancing.

C. Repair, replacement or adjustment of each item shall be performed by the installing contractor.

D. Involves all new construction and those elements of existing construction which are affected by this project.

1.3 TESTING AND BALANCING - EXTENT OF WORK:

A. This work incorporates a confirming checkout of construction work, an individual component activation and an overall system activation into one work program which shall serve as the transition period from the Contractor's job to Owner's facility.

B. The TAB Contractor shall be skilled in the operation and manipulation of systems and in the direction of parties involved in the work.

C. Conduct and participate in the startup and shakedown of all mechanical systems installed and modified in this contract; test adjust and balance these systems to obtain optimum performance at a level which minimizes the required energy input, prepare and submit a

complete report of work done and the final system condition obtained, participate in the instruction of Owner's personnel in the proper operation of systems and equipment.

D. Involves all new construction and those elements of existing construction which are affected by this project.

1.4 QUALIFICATIONS OF SYSTEM COMMISSIONING AND TAB TEAM:

A. Representatives of the General Contractor, Mechanical Contractor, etc., and Electrical Contractor shall be available on a daily basis through the commissioning and adjustment period. These men shall be experienced journeymen with prior experience in system operation and with specific experience on the construction of this project.

B. Balancing shall be done by an independent firm specializing in this work. A definition of independent shall mean the firm is not associated with any engineering, contracting, or manufacturing firm and derives its income solely from testing, adjusting and balancing mechanical systems. The approved firms to do this work are Barnett, Inc., Payson, Utah; Bob’s Test & Balance, Salt Lake City, Utah.

C. The balancing work including air and hydronic portions shall be performed by the same firm having total responsibility for the final testing, adjusting and balancing of the entire system. A principal of the firm shall be directly involved in the project.

D. The independent testing and balancing firm shall furnish all necessary tools, scaffolding and ladders that are required and shall provide all required instruments, take all readings and make all necessary adjustments.

E. After all tests and adjustments are made a detailed written report shall be prepared and submitted for review, and shall bear the signature of the professional supervising the work. Final acceptance of this project will not be made until a complete and satisfactory report is received. Furnish two copies of the report.

PART II - EXECUTION, SYSTEM COMMISSIONING

2.1 PRE-STARTUP INSPECTION:

A. The pre-startup inspection of all systems shall provide for verifying that each piece of equipment is properly installed and prepared for startup.

B. All pertinent items shall be checked, including but not necessarily limited to the following:

1. Removal of shipping stops.

2. Vibration isolators properly aligned and adjusted.

3. Flexible connections properly aligned.

4. Belts properly adjusted.

5. Belt guards and safety shields in place.

6. Safety controls, safety valves and high or low limits in operation.

7. All systems properly filled.

8. Filters in place and seal provided around edges.

9. Fire dampers and smoke dampers properly installed and linked. Access doors provided for every damper.

10. Pressure and temperature gauges installed.

11. All test stations and measuring devices installed.

12. Initial lubrication of equipment is complete.

13. Filters and strainers are clean.

14. Motor rotations are correct.

15. Voltages match nameplate.

16. Control system is in operation.

17. All interlocks are wired and verified.

18. All controls have been connected and verified.

19. All valves, dampers and operators are properly installed and operating.

20. All ductwork is installed and connected.

21. All other items necessary to provide for proper startup.

2.2 FIRST RUN INSPECTION:

A. Recheck all items outlined in pre-startup inspection to insure proper operation.

B. Check the following items:

1. Excessive vibration or noise.
2. Loose components.
3. Initial control settings.
4. Motor amperages.
5. Heat buildup in motors, bearings, etc.
6. Control system is properly calibrated and functioning as required.

C. Correct all items which are not operating properly.

2.3 SYSTEM OPERATION INSPECTION:

A. Observe mechanical systems under operating conditions for sufficient time to insure proper operation under varying conditions, such as day-night and heating-cooling.

1. Periodically check the following items:

2. Strainers and filters.

3. Visual checks of air flow for "best guess" settings for preparation for system air balancing under section applying.

4. Control operation, on-off sequences, system cycling, etc.

5. Visual checks of water flow, seals, packings, safety valves, operation pressures and temperature.

6. Cleaning of excessive oil or grease.

7. Dampers close tightly.

8. Valves close tightly.

9. System leaks.

10. All other items pertaining to the proper operation of the mechanical system whether specifically listed or not.

PART III - EXECUTION - TESTING AND BALANCING

3.1 TOTAL MECHANICAL SYSTEM BALANCE:

A. The mechanical systems balance involves elements of the work of the General Contractor, the Electrical Contractor, the Mechanical Contractor, the Sheet Metal Contractor and the Controls Contractor. Total system balance requires that all elements be not only individually correct, but also correct as a composite system. Therefore, participation of all parties shall be required in the test and balance procedure.

B. Prior to beginning work, a written description of the anticipated sequence of action shall be submitted to the Architect/Owner for review and comment.

C. The testing and balance specialist shall review the contract drawings during the bid period and shall advise the Architect of any modifications to the layout which may be needed to facilitate the balance procedure. Modifications will be incorporated into the contract by Addendum during the bidding period.

D. The test and balance specialist shall visit the project from time to time during the rough installation making a thorough inspection of those items which will affect his subsequent work. He shall advise the Contractor in writing with a copy to the Architect of any work required by the contract which is not being performed adequately. This is in addition to the regular inspection efforts of the Architect and Engineer. Particularly note needed valves, dampers, access doors, thermometers, pressure gauges, belts and drives, diffuser styles, strainers and filters, etc.

3.2 AIR SYSTEMS BALANCE:

A. Before any adjustments are made, check the systems for such items as dirty filters, duct leakage, filter leakage, damper leakage, equipment vibrations, correct damper operations, etc. Adjust all fan systems, major duct sections, registers, diffusers, etc., to deliver design air quantities within +5%. Individual air outlets, when one of three or more serve

a space may have a tolerance of 10 percent from the average. Design static pressure is based on filters approximately 50% loaded with dirt. Pressure drop across filters during balancing shall be simulated to that condition. After balancing is completed check motor amperage with the filters clean.

B. Adjust supply, exhaust and recirculation air systems towards air quantities shown on drawings. Establish a proper relationship between supply and exhaust. Follow proportional balance procedures outlined by AABC and/or SMACNA for such work.

C. Distribution system shall be further adjusted to obtain uniform space temperatures free from objectionable drafts and noise within the capabilities of the system.

D. Exchange sheaves and/or belts as needed to adjust the RPM of all fans so they handle specified air quantity.

E. Verify the function of all Variable Frequency Drives and related controls.

3.3 MAJOR EQUIPMENT: The Testing and Balancing Contractor shall work with the Controls Contractor and Electrician in placing heat exchangers, pumps, fans and other major equipment in operation. The factory representative of the equipment manufacturer shall also participate in a team effort to place the system(s) in operation, adapt to all anticipated operating modes and make adjustments as required to obtain correct operation. The Design Engineer and the Owner's Representative shall witness the final operating sequences.

A. Use proportional balance techniques so that in every case, at least one terminal valve is set for full flow at wide open, and at least one branch valve is wide open at full flow, others equivalent.

3.4 CONTROL SYSTEMS: The Testing and Balancing Contractor shall go through the entire control system with the Controls Contractor verifying proper operation of each and every device and the proper function of each system. Certify such effort in the report.

3.5 MISCELLANEOUS:

A. Observe and note all furnished thermal overload protection in the data sheets. If thermal overload protection is incorrect, the trade which furnished the overload devices shall furnish and install the correct size overload protection devices. It shall be the responsibility of the balancing firm to confirm that proper overload protection has been installed at the completion of the job.

B. Measure and set any special conditions such as minimum air quantities; coordinate outside air, return air and relief air damper operation; check and adjust outside and return air intakes so that the system will deliver substantially the same volume on either; make tests and record data as required in "REPORT" below.

C. All balancing devices, i.e. dampers and valves, shall be clearly marked as to the final balanced position. Plug all test holes, replace access doors and belt guards.

D. Upon request, based on perceived need, make 24-hour space temperature recordings. Any required rebalance of the system shall be performed without additional cost.

E. Upon request, a representative of the balancing firm performing the work shall demonstrate fluid flow quantities shown in the report by reading back outlets or terminals

selected specifically or at random by the Design Engineer. It is understood that the operating mode of the system shall be the same for read-back as it was during balancing.

3.6 REPORT:

A. Provide a bound report in four copies containing a general information sheet listing instruments used, method of balancing, altitude correction, and manufacturer's grille, register and diffuser data.

B. Provide equipment data sheets listing make, size, serial number, rating, etc. of all mechanical equipment including fans, air controllers, pumps, motors, starters and drives. Operating data shall include rotational speed, inlet an outlet pressures, pressure drop across filters, coils, an other system components, pump heads, and measured motor current and voltage.

C. Balancing data sheets shall indicate the required and actual CFM of all supply, return and exhaust outlets or inlets, and be totaled and summarized by systems.

D. Include a reduced set of contract drawings with outlets marked for easy identification of the signation used in the data sheets.

E. Note any abnormal or notable conditions not covered in the above.

F. Keep a daily log of all work performed, with a list of work scheduled for each day and the workers on the job.

END OF SECTION 230593

SECTION 230700 - MECHANICAL INSULATION

PART I - 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. Division-23, Section 230000 - General Mechanical Requirements applies to work of this section.

1.2 SUMMARY:

A. Extent of mechanical insulation required by this section is indicated on drawings and schedules as required by the current International Energy Code, and by requirements of this section. Use no asbestos in this work. Include restorations of insulations of damaged work including repair of damaged existing insulation due to new work.

B. Types of mechanical insulation specified in this section include the following:

1. Ductwork System Insulation:

a. Fiberglass.
b. Rigid Flexible Wrap.

C. Refer to Division-23 section "Supports and Anchors" for protection saddles, protection shields, and thermal hanger shields.

D. Refer to Division-23 section "Ductwork" for duct linings.

E. Refer to Division-23 section "System Identification" for installation of identification devices for piping, ductwork, and equipment.

1.3 QUALITY ASSURANCE:

A. Manufacturer’s Qualifications: Firms regularly engaged in manufacture of mechanical insulation products, of types and sizes required, whose products have been in satisfactory use in similar service for not less than 3 years.

B. Installer’s Qualifications: Firm with at least 5 years successful installation experience on projects with mechanical insulations similar to that required for this project.

C. Flame/Smoke Ratings: Provide composite mechanical insulation (insulation, jackets, coverings, sealers, mastics and adhesives) with flame-spread index of 25 or less, and smoke-developed index of 50 or less, as tested by ASTM E 84 (NFPA 255) method.

1.4 SUBMITTALS:

A. Product Data: Submit manufacturer's specifications and installation instructions for each type of mechanical insulation. Submit schedule showing manufacturer's product number, k-value, thickness, and furnished accessories for each mechanical system requiring

insulation.

B. Maintenance Data: Submit maintenance data and replacement material lists for each type of mechanical insulation. Include this data and product data in maintenance manual.

1.5 DELIVERY, STORAGE AND HANDLING:

A. Deliver insulation, coverings, cements, adhesives and coatings to site in containers with manufacturer's stamp or label affixed showing fire hazard ratings of products.

B. Protect insulation against dirt, water and chemical and mechanical damage. Do not install damaged or wet insulation; remove from project site.

PART II - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS:

A. Manufacturer: Subject to compliance with requirements, provide mechanical insulation materials of one of the following (except as noted):

1. Armstrong World Industries, Inc.
2. Babcock and Wilcox Co., Insulating Products Div.
3. CertainTeed Corp.
4. Knauf Fiber Glass GmbH.
5. Manville Products Corp.
6. Owens-Corning Fiberglass Corp.
7. Pittsburgh Corning Corp.
8. Rubatex Corp.

2.2 PIPING INSULATION MATERIALS:

A. Preformed Fiberglass Piping Insulation: ASTM C 547. (Class 1 for use to 450°F (230°C); Class 2 for use to 650°F (345°C); Class 3 for use to 1200°F (650°C).

B. All insulation exposed to sunlight or installed outdoors shall be protected with two coats of Armstrong Wb Armaflex Finish.

C. Jackets for Piping Insulation: All purpose (ASJ) fire retardant jacket, ASTM C 921, Type I for piping with temperatures below ambient, Type II for piping with temperatures above ambient. Type I may be used for all piping at Installers option.

D. Encase pipe fittings insulation with one-piece premolded PVC fitting covers, fastened as per manufacturer's recommendations.

E. Staples, Bands, Wires, and Cement: As recommended by insulation manufacturer for applications indicated.

F. Adhesives, Sealers, and Protective Finishes: As recommended by insulation manufacturer for applications indicated.

G. Insulation Protection Shields: MSS Type 40; of length recommended by manufacturer to prevent crushing of insulation.

H. Thermal Hanger Shields: constructed of 360 degrees insert of high density, 100 psi, water-proofed calcium silicate, encased in 360 degrees sheet metal shield. Provide assembly of same thickness as adjoining insulation

2.3 DUCTWORK INSULATION MATERIALS:

A. Rigid Fiberglass Ductwork Insulation: ASTM C 612, Class 1. Class 1 - 400°F (204°C); Class 2 - 400°F (204°C); Class 3 - 850°F (454°C); Class 4 - 1000°F (538°C); Class 5 - 1800°F (982°C); Class 1 - 10 lbs/ft^3; Class 2, 3 and 4 - 12 lbs/ft^3; class 5 - 20 lbs/ft^3.

B. Flexible Fiberglass Ductwork Insulation: ASTM C 553, Type I, Class B-4. Type 1 - resilient, flexible; Class B-1 - 0.65 lbs/ft^3; Class B-2 - 0.75 lbs/ft^3; Class B-3 - 1.0 lbs/ft^3; Class B-4 - 1.5 lbs/ft^3; Class B-5 - 2.0 lbs/ft3; Class B-6 - 3.0 lbs/ft^3; Type II - flexible; Class F-1 - 4.5 lbs/ft^3; Type III - semirigid; Class F-2 - 4.5 lbs/ft^3.

C. Jackets for Ductwork Insulation: ASTM C 921, Type I for ductwork with temperatures below ambient; Type II for ductwork with temperatures above ambient.

D. Ductwork Insulation Accessories: Provide staples, bands, wires, tape, anchors, corner angles and similar accessories as recommended by insulation manufacturer for applications indicated.

E. Ductwork Insulation Compounds: Provide cements, adhesives, coatings, sealers, protective finishes ad similar compounds as recommended by insulation manufacturer for applications indicated.

2.4 FIRE/SMOKE ENCASEMENT:

A. Any and all non plenum rated PVC, and any other plastic piping located in return air and supply air plenums shall be encased in rated flame and smoke system. The encasement shall be equal to Firemaster “Plastic Pipe Fire Protection System.” The enclosure shall meet all codes.

PART III - EXECUTION

3.1 GENERAL:

A. Piping insulation shall be fiberglass one-piece preformed pipe insulation, class related to temperature, with all purpose (ASJ) fire retardant jacket, additional jacketing as noted.

B. Fittings and valves shall be insulated and covered with Zeston covers.

C. All cold water, chilled water, roof drains or any other lines upon which condensate moisture could form, shall have a vapor-proof jacket.

D. Fire and smoke hazard for a complete insulation system shall not exceed:

1. Flame spread - 25
2. Fuel contribution - 50
3. Smoke development - 50

E. Hangers shall not contact pipe where pipe is specified to be insulated.

3.2 INSPECTION:

A. Examine areas and conditions under which mechanical insulation is to be installed. Do not proceed with work until unsatisfactory conditions have been corrected in manner acceptable to Installer.

3.3 DUCTWORK SYSTEM INSULATION:

A. Insulation Not Required: Do not insulate lined ductwork.

B. Hot, Cold and Dual Temperature Ductwork:

1. Application Requirements: Insulate the following ductwork:

a. Outdoor air intake ductwork between air entrance and fan inlet or HVAC unit inlet.

b. HVAC supply ductwork between fan discharge, or HVAC unit discharge, and room terminal outlet. Insulate neck and bells of supply diffusers.

c. HVAC return ductwork between room terminal inlet and return fan inlet, or HVAC unit inlet: except omit insulation on return ductwork located in return air ceiling plenums.

d. HVAC plenums and unit housings not pre-insulated at factory or lined.

e. HVAC relief air plenums and ductwork.

2. Insulate each interior ductwork system specified above with one of the following types and thicknesses of insulation:

a. Rigid fiberglass: Class 1, 1-1/2" thick, increase thickness to 2" in machine, fan and equipment rooms. Insulation shall be minimum R-6.

b. Flexible Fiberglass: Type 1, Class B-4, 1-1/2” lb/ft^3 density, 1-1/2" thick, application limited to concealed locations. Insulation shall be minimum R-6.

3. Insulate ductwork systems exterior to the building with on eof the following types and thicknesses of insulation.

a. Rigid Fiberglass: Class 1, 3” thick. Insulation shall be minimum R-12.

b. Flexible Fiberglass: Type 1, Class B-4, 1-1/2” lb/ft^3, 3” thick. Insulation shall be minimum R-12.

C. High and Medium Velocity Duct: Insulate externally with type 1, class B-4 (1-1/2 lb/ft^3 density) 1-1/2" thick fiberglass faced duct wrap with factory applied foil scrim Kraft facing U.L. 723 label.

D. Duct Insulations:

1. Wrap insulation snugly on the ductwork such that maximum thickness is

maintained. Butt all circumferential joints and overlap longitudinal joints a minimum of 2". Adhere insulation with 4" strips of Insulation Bonding Adhesive, at 8" on center.

2. On circumferential joints, staple the 2" flange of the facing with 9/16" flare-door staples on 6" centers and taped with minimum 3" wide foil reinforcing Kraft tape. Tape all pin penetrations or punctures in the facing.

3.4 INSTALLATION OF DUCTWORK INSULATION:

A. General: Install insulation products in accordance with manufacturer's written instructions, and in accordance with recognized industry practices to ensure that insulation serves its intended purpose.

B. Install insulation materials with smooth and even surfaces.

C. Clean and dry ductwork prior to insulating. Butt insulation joints firmly together to ensure complete and tight fit over surfaces to be covered.

D. Maintain integrity of vapor-barrier on ductwork insulation, and protect it to prevent puncture and other damage.

E. Extend ductwork insulation without interruption through walls, floors and similar ductwork penetrations, except where otherwise indicated.

F. Lined Ductwork: Except as otherwise indicated, omit insulation on ductwork where internal insulation or sound absorbing linings have been installed.

G. Ductwork Exposed to Weather: Protect outdoor insulation from weather by installing outdoor protective finish or jacketing as recommended by manufacturer.

H. Corner Angles: Install corner angles on external corners of insulation on ductwork in exposed finished spaces before covering with jacketing.

3.5 PROTECTION AND REPLACEMENT:

A. Replace damaged insulation which cannot be repaired satisfactorily, including units with vapor barrier damage and moisture saturated units.

B. Protection: Insulation Installer shall advise Contractor of required protection for insulation work during construction period to avoid damage and deterioration.

END OF SECTION 230700

SECTION 230719 - REFRIGERENT PIPING INSULATION

PART 1 GENERAL

1.1 SUMMARY

A. Includes But Not Limited To
   1. Furnish and install insulation on above-ground refrigerant piping and fittings as described in Contract Documents.

B. Related Sections
   1. Section 232300 - Refrigerant Piping Systems

PART 2 PRODUCTS

2.1 MATERIALS

A. Flexible Foamed Pipe Insulation
   1. Thickness -
      a. 1/2 inch for one inch outside diameter and smaller pipe.
      b. 3/4 inch for 1-1/8 through 2 inch outside diameter pipe.
      c. One inch for 2-1/8 inches outside diameter and larger pipe (two layers of 1/2 inch.)
      d. One inch sheet for fittings as recommended by Manufacturer.
   2. Approved Products -
      a. AP Armaflex by Armacell
      b. Rubatex

B. Joint Sealer
   1. Approved Products -
      a. Armaflex 520 by Armacell
      b. BFG Construction Adhesive No. 105
      c. Rubatex R-373

C. Insulation Tape
   1. Approved Products -
      a. Armaflex AP Tape by Armacell
      b. R-180-FS Tape by Rubatex

D. Exterior Finish
   1. Approved Products -
      a. WB Armaflex Finish by Armacell
      b. Protective Coating 67x944 by Rubatex

2.2 MANUFACTURERS

A. Armacell, Mebane, NC (800) 232-3341 www.armaflex.com
B. BFG Industries, West Columbia, SC (800) 845-2220 or (803) 796-1380
C. Rubatex, Roanoke, VA 782-2839 or (540) 561-6000 www.rbxcorp.com

PART 3 EXECUTION

3.1 INSTALLATION

A. General
1. Install insulation in snug contact with pipe and in accordance with Manufacturer's recommendations.
a. Insulate flexible pipe connectors.
b. Insulate thermal expansion valves with insulating tape.
c. Insulate fittings with sheet insulation and as recommended by Manufacturer.
2. Slip insulation on tubing before tubing sections and fittings are assembled keeping slitting of insulation to a minimum.
3. Do not install insulation on lines through clamp assembly of pipe support. Butt insulation up against sides of clamp assembly.
4. Provide 6 inch long, 20 ga galvanized steel sleeve around pipe insulation at each support. Extend insulation through pipe support clamps.
5. Stagger joints on layered insulation. Seal joints in insulation.
6. Install insulation exposed outside building so 'slit' joint seams are placed on bottom of pipe.
7. Paint exterior exposed insulation with two coats of specified exterior finish.

B. System Requirements
1. Install insulation on refrigerant on all refrigerant suction, liquid and discharge piping and fittings, including thermal bulb, from thermal expansion valve.

END OF SECTION 230719

SECTION 230900 - HVAC CONTROL SYSTEMS

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. Division-23 General HVAC Requirements sections apply to work of this section.

1.2 SUMMARY:

A. Extent of control systems work required by this section is indicated on “H” drawings and schedules, and by requirements of this section.

1. This work has a multi-faceted HVAC Controls responsibility.

a. Provide Local Control Panels (LCPs) as described below to manage and control the HVAC devices and systems.

b. Controls for HVAC related systems is to be provided by the Division 23 HVAC controls contractor using components described in this 23 09 00 HVAC Section.

2. Follow control sequences as described in these documents. It is common for sequences and set points to require adjustment in the field to accommodate the final character of overall assemblies. Allow time to make adaptations and adjustments as needed. System setups are often seasonally variable. Re-visit the operation at least four times during the first year to make sure that the functions of the systems are being satisfied.

3. During the bidding period, thoroughly review the documents and request clarification of insufficient, ambiguous or contradictory presentation. The fundamental assumption is that there is a duty to be met and that the documents require as a minimum that devices, materials and installation will be provided to result in fully coherent and functional systems. Provide devices with any and all optional features required to obtain required function. Provide devices of materials that are compatible with the plant environment.

B. Refer to other Division-23 HVAC sections for installation dampers in mechanical systems.

C. Refer to Division-26 sections for the following work.

1. Interlock wiring between electrically-operated equipment units; and between equipment and field-installed control devices.

a. Interlock wiring specified as factory-installed is work of this section.

D. Provide all field electrical work complying with and as work of the Division-26 sections.

1. Control wiring between field-installed equipment, controls, indicating devices, and unit control panels.

2. 120 volt service; required by instrumentation and control systems.

E. Participate in "System Commissioning, Testing and Balancing".

1.3 QUALITY ASSURANCE:

A. Manufacturer's Qualifications: Firms regularly engaged in manufacture of instrumentation and electric control equipment, of types and sizes required, whose products have been in satisfactory use in similar service for not less than 5 years. System shall be Base Bid Honeywell.

B. Installer's Qualifications: Firms and workmen specializing and experienced in programmable logic control, pneumatic and electric control system installations for not less than 5 years. Installer shall be under the direction of the instrumentation subcontractor and able to act as an authorized agent thereof.

1.4 SUBMITTALS:

A. Product Data: Submit manufacturer's technical product data for each control device furnished, indicating dimensions, capacities, performance characteristics, electrical characteristics, finishes of materials, and including installation instructions and start-up instructions. Confirm that devices offered are suitable for the indicated duty, inherently hardened against the adverse environment of the wastewater treatment plant. Note that exposed copper and copper bearing materials (i.e. bronze) are inappropriate for this duty. Provide devices of stainless steel, etc.

B. Shop Drawings: Submit material catalog sheets and shop drawings for each control system, containing the following information:

1. Schematic flow diagram of system showing, but not limited to, RTU’s, split system air conditioning systems, unit heaters, control devices, etc.

2. Label each control device with final designated setting or adjustable range of control.

3. Identify all required electrical wiring. Clearly differentiate between portions of work that are factory-installed and portions to be field-installed. Note contract responsibility to provide complete system regardless of delegation. Completely interface with and show existing installation in the existing building.

4. Provide details of faces of control panels, including controls, instruments, and labeling.

5. Include verbal written description of sequence of operation. Confirm correct function of proposed sequences.

C. SAMPLES: Submit sample of each type of proposed sensors.

D. MAINTENANCE DATA: Submit maintenance instructions and spare parts lists. Include this data, product data, and shop drawings in maintenance manuals; in accordance with requirements of Section 23 05 93.

1.5 REFERENCES:

A. CODES AND STANDARDS:

1. Electrical Standards: Provide electrical products which have been tested, listed and labeled by UL and comply with NEMA standards.

2. NEMA Compliance: Comply with NEMA standards pertaining to components and devices for electric control systems.

3. NFPA Compliance: Comply with NFPA 90A "Standard for the Installation of Air Conditioning and Ventilating Systems" where applicable to controls and control sequences.

4. Comply with NEPA 70, "National Electric Code" for all electrical installation.

1.6 DELIVERY, STORAGE, AND HANDLING: Provide factory shipping cartons for each piece of equipment, and control device. Maintain cartons through shipping, storage and handling as required to prevent equipment damage, and to eliminate dirt and moisture from equipment. Store equipment and materials inside and protected from weather.

1.7 INSTRUCTION OF OWNER'S PERSONNEL:

A. Purpose is to provide a transition of the systems from the Contractor to the Owner, leaving the Owner's personnel familiar with and well qualified to operate and maintain the systems.

B. Instruction shall cover the purpose and function of each system and its components, to show proper operating technique, to show proper maintenance technique.

C. Prepare an outline of information to be conveyed, list materials available for reference. Submit to Engineer along with a proposed schedule of instruction. Schedule to allow individual time for each trade and each system.

D. Convey information in formal classroom session. Teachers shall include qualified contractor personnel and sales representatives for each major piece of equipment. Go from the classroom to the actual location to graphically illustrate concepts discussed.

1.8 WARRANTIES:

A. As part of the overall project warranty, furnish individual manufacturer warranties for each piece of equipment for a period of not less than one year from date of Owner's beneficial use (substantial completion not date of delivery).

B. Warrant the overall assembly of equipment, materials and labor comprising these systems.

1.9 CLEANING AND LUBRICATION: All instruments, control panel and control piping shall be thoroughly cleaned before final acceptance. Provide lubrication for all furnished equipment.

1.10 TESTING AND ADJUSTING OF SYSTEM:

A. During the system commissioning, testing and balancing of the various building systems, have a controls representative(s) present and available to interpret and adjust controls as needed. Demonstrate and report the integrity and accuracy of each function and control point.

B. At the termination of the testing period, the Controls representative shall spend one working day instructing the Owner's operating personnel in the control system operation, and one working day checking each system for day-night and manual override with the Owner's operating personnel on each air handling system. A complete operating booklet shall be provided and used during the training period. Schedule this training with the Owner and Mechanical Contractor.

Since system performance is partly a function of climatic conditions, the Controls contractor shall be available during the changing seasons of the warranty period to make further adjustments and modifications if required. A final complete check of all systems shall be made at the conclusion of the one year warranty period.

PART 2 - PRODUCTS

2.1 CONTROL CABINETS: Furnish stamped steel cabinets with hinged door(s) and locking latches by Hoffman or equal, to protect and conceal all power and control terminations for the air handling units, and independently for the local HVAC control devices. Arrange components neatly to provide adequate maintenance opportunity and proper device function. Label all components, numerically code all piping and wiring. Terminate all wiring at terminal blocks. Provide engraved plastic labels for all panel face devices.

2.2 AUXILIARY RELAYS:

A. Light Duty - as required. (verify current model number)

B. Heavy Duty - Square D, Class 8501, Type X. (For motor control)

2.3 ACCESSORIES

A. Provide devices with all components needed to make a complete and functional installation.

2.4 SOURCE QUALITY CONTROL

A. Factory-calibrate each instrument according to manufacturer's standard at a facility that is traceable to the NIST.

B. Provide complete documentation covering the traceability of all calibration instruments.

2.5 PACKAGED ROOFTOP UNIT CONTROL

A. Honeywell LCBS Connect control system with cloud-based gateway. Components include: LCBS Controller, LCBS Wall Module (thermostat), and LCBS Gateway.

B. Provide all components needed to integrate the Honeywell LCBS Connect system into the RTU unit logic board and connect the system to the network (Honeywell Cloud) for remote monitoring. Coordinate all network connection and login requirements with the owner.

PART 3 – CONTROL SEQUENCES AND EXECUTION

3.1 GENERAL:

A. Provide control systems to manage and manipulate mechanical equipment in a functional and energy-conserving way.

B. Provide ATC panels with terminal block connections for interface to exhaust fans and dampers, etc. Field coordinate panel locations.

3.2 ROOFTOP UNIT HEATING AND COOLING AIR UNIT CONTROL SEQUENCE (RTU-1 thru 5):

A. The rooftop units are provided with self-contained controls equipped as required to communicate with and be controlled by a Honeywell LCBS Connect control system.

B. On call for cooling as sensed by the wall-mounted thermostat controller, each rooftop unit's cooling function is enabled to satisfy the discharge cooling set point temperature at 55°F (adj.).

C. On call for heating as sensed by the wall-mounted thermostat controller, each rooftop unit's heating function is enabled to satisfy the discharge heating set point temperature at

95°F (adj.).

D. The unit shall operate in full outside air economizer mode when the outdoor conditions permit as sensed by the unit logic board.

E. Built-in safeties shut the rooftop units down should unusual conditions occur.

3.3 SPLIT SYSTEM AIR CONDITIONING UNIT (SAC-1):

A. The split system air conditioning unit operates through its own factory-furnished controls to provide cooling to its respective space through a signal from the local space temperature sensor furnished with the unit

3.4 ELECTRIC WALL AND RADIANT HEATERS:

A. Each electric wall and radiant heater cycles on through its own controls to satisfy the heating set point temperature when activated by either an integral or wall-mounted thermostat. Wiring by Division 26.

3.5 CEILING EXHAUST FANS (CEF-1 thru 6):

A. CEF-1 thru 5 shall each be controlled through the local light switch and programmed to stay on 15 minutes after the lights turn off. Wiring by division 26. The speed of each fan shall be adjustable as needed through its respective fan speed controller.
   1. When any fan (CEF-1 thru 5) is powered the corresponding control damper at the gravity ventilation hood shall open.

B. CEF-6 shall each be controlled through a separate switch. Wiring by division 26. The speed of the fan shall be adjustable as needed through its respective fan speed controller.
   1. When CEF-6 is powered the corresponding control damper at the gravity ventilation hood shall open.

END OF SECTION 230900

SECTION 232300 - REFRIGERATION PIPING AND EQUIPMENT

PART 1 - GENERAL

1.1 GENERAL MECHANICAL REQUIREMENTS:

A. All pertinent sections of Section 23 00 00 - General Mechanical Requirements are a part of the work described in this section.

1.2 SUMMARY:

A. This section specifies:

1. Refrigeration piping systems and equipment for split air conditioning systems.
2. Piping, valves, specialties.

1.3 STANDARDS:

A. International Building Code/International Mechanical Code

B. Local Codes and Ordinances

C. State Pressure Vessel Regulations

D. EPA Requirements.

1.4 SHOP DRAWINGS/SUBMITTALS:

A. Submit a list of all materials to be used indicating brand or source, type and service.

B. Submit shop drawings for all equipment, valves and specialties, including shop drawing showing proposed pipe routing, sizing, valving, etc.

1.5 CONTRACTOR QUALIFICATION:

A. The Piping Contractor for this work shall be licensed as a firm in the Contractor state of origin and in the state where the work is performed.

B. The Contractor shall have a publicly registered bonding capacity of sufficient amount to cover this work and all other work in progress by the Contractor.

C. All workmen employed in the project shall carry state licenses as journeyman or apprentice pipe fitters with additional certification for welders.

1.6 SCOPE OF THE WORK:

A. Furnish and install all field fabricated refrigeration systems and related work to effect a complete installation.

1. Provide and install complete refrigeration piping systems and equipment for split air conditioning systems as indicated in the Contract Documents and as specified in this section. Make systems fully operational.
2. Piping, valves, specialties.
3. Other work indicated on the drawings.

1.7 INSTRUCTION OF OWNER'S PERSONNEL:

A. Purpose is to provide a transition of the systems from the Contractor to the Owner, leaving the Owner's personnel familiar with and well qualified to operate and maintain the systems.
B. Instruction to cover purpose and function of each system and its components, to show proper operating technique, to show proper maintenance technique.

1.8 WARRANTIES: See Section 23 00 00.

PART II - MATERIALS AND METHODS

2.1 EQUIPMENT: All major items of refrigeration equipment shall be as specified in the equipment schedules on the drawings and shall be furnished complete with all accessories normally supplied with the catalog item listed and all other accessories necessary for a complete and satisfactory operating system.

2.2 PIPING MATERIALS: Piping materials shall be as follows unless otherwise indicated on the applicable contract drawing:

A. Pipe: "ACR" Type L, hard drawing, degreased, sealed at mill copper tubing, ASTM B88-62, cleaned and sealed at the mill. Pre-charged refrigerant lines shall not be used.

B. Fittings: Long radius, wrought copper type equal to Mueller Streamline, ASA B16.22.1963.

2.3 VALVES, SPECIALTIES, ETC:

A. Filter-Dryer: On lines smaller than 3/4" O.D. filter-dryer shall be a sealed type using male flare fittings. Size shall be full line size. Filter-dryer shall be Sporlan, Mueller or Alco.

B. Sight Glass: Shall be a combination moisture and liquid indicator with protection cap. Sight glass shall be Alco, Mueller, Sporlan or Henry. Size shall be full line size.

C. Flexible Connection: Corrugated bronze hose with single layer of stainless steel exterior braiding, minimum 9 inches long with copper tube ends; for system working pressure.

D. Solenoid Valve:

1. Valve: ARI 760, pilot operated, copper or brass body and internal parts, synthetic seat, stainless steel stem and plunger assembly with flared, solder, or threaded ends; for system working pressure. Stem shall permit manual operation in case of coil failure.

2. Coil Assembly: UL listed, replaceable with molded electromagnetic coil, moisture and fungus proof, with surge protector and color coded lead wires, integral junction box 24 volt, confirm and coordinate with DDC controls.

2.4 REFRIGERANT AND LUBRICATING OIL: The Contractor furnish and install all of the refrigerant required to develop the system to its full rating, and in addition to the initial charge, he shall be required to provide, without cost to the Owner, all required refrigerant for the proper operation of the refrigeration apparatus during the first year's operation. The contractor shall be required to provide the initial charge of lubricating oil for all refrigeration apparatus and related equipment. Loss of refrigerant and oil during the first year of operation shall be made good at the contractor's expense.

PART III - EXECUTION:

3.1 INSTALLATION:

A. General: Use best practices of the trade in all installation. Installation shall conform with the American Standard Code for Pressure Piping, ASA B31.5-1962, Refrigeration Piping. Installed piping shall not interfere with the operation and accessibility of doors or windows; shall not encroach on aisles, passageways, and equipment; and shall not interfere with the servicing or maintenance of equipment. Pipe shall be cut accurately to measurements established at the construction site and shall be worked into place without springing or forcing, properly clearing all openings and equipment. Cutting or weakening of structural members to facilitate piping installation is not permitted. Pipes shall have burrs removed by reaming and shall be so installed as to permit free expansion and contraction without damage to joints or hangers. Piping shall be installed in a straight manner, free from traps, and shall be provided with capped or plugged ends, as it is erected, to prevent dirt from entering the system. The piping system shall be provided with isolating hangers as required to prevent vibration of the compressor operation being carried to the building structure. The piping system shall be provided with gauges as required for the operation of the system, and the suction connection from each coil shall be provided with a test thermometer wall in the pipe for adjustment of the thermostatic expansion valves.

B. Slope of Refrigerant Lines: Slope suction lines down toward compressor 1" per 10 feet. For furnace condensing units only, locate oil traps every 10 feet at all vertical rises against flow in suction lines. Suction line traps shall be standard one-piece traps. Do not install oil traps on split AC systems (SAC, VAC) unless recommended by the manufacturer.

C. Cleanliness: All refrigerant lines and fittings shall be absolutely clean to avoid system operating difficulties and contamination. Use a good cleaning agent such as trichlorethylene.

D. Joints:

1. Brazed joints: Tubing shall be cut square and burrs removed. Both inside of fittings and outside of tubing shall be well cleaned with steel wool, wire brush, or fine emery cloth before sweating.

2. An inert gas (such as oil pumped dry nitrogen) shall be continuously passed through the copper piping when brazing joints to prevent formation of copper oxide. Care shall be taken to prevent annealing of fittings and tubing when making connections. Joints shall be made with silver bearing brazing material.

3.2 TESTING OF REFRIGERATION PIPING SYSTEM: After the installation of the refrigeration piping system has been completed and before insulation is applied, all pipes shall be tested and proven tight for a period of 24 hours at a pressure of 300 pounds per square inch using oil pumped dry nitrogen.

3.3 EVACUATION AND CHARGING: After completion of the piping pressure test, the refrigeration systems shall be evacuated and dehydrated using a vacuum pump capable of producing at least 1 mm Hg absolute. The following procedure shall be followed unless otherwise noted:

A. Connect an accurate high vacuum gauge, such as Stokes or Zimmeril gauge to the system.

B. Connect the vacuum pump to both the high and low side of the system. Leave the compressor suction and discharge service valves closed. Start the vacuum pump.

C. Keep ambient air temperatures above 60^{o} during the evacuation process.

D. Operate the vacuum pump until the system is evacuated to 2.5 mg Hg absolute.

E. Break the system vacuum with oil pumped dry nitrogen. Open the compressor suction and discharge service valves and re-evacuate the system to 2.5 mm Hg absolute.

F. After the system has been double evacuated to 2.5 mm Hg absolute, close the vacuum pump suction valve and stop the pump. Allow the system to stand under a vacuum a minimum of 12 hours. If no noticeable rise in pressure has taken place after 12 hours, the system may be charged. This test shall be made in the presence of the Owner's representative.

END OF SECTION 232300

SECTION 233100 - DUCTWORK

PART I - 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. Division-23 Basic Mechanical Materials and Methods Sections apply to work of this section.

1.2 SUMMARY:

A. Extent of metal ductwork is indicated on drawings and in schedules, and by requirements of this section.

B. Types of ductwork required for the project include the following:

1. Round
2. Rectangular
3. Spiral

C. Exterior Insulation of metal ductwork is specified in other Division-23 sections, and is included as work of this section.

D. Refer to other Division-23 sections for exterior insulation of metal ductwork; not work of this section.

E. Refer to other Division-23 sections for ductwork accessories; not work of this section.

F. Refer to other Division-23 sections for fans and air handling units; not work of this section.

G. Refer to other Division-23 sections for mechanical controls; not work of this section.

H. Refer to other Division-23 sections for louvers; not work of this section.

I. Refer to other Division-23 sections for filters; not work of this section.

J. Refer to other Division-23 sections for air control boxes; not work of this section.

K. Refer to other Division-23 sections for grilles and diffusers; not work of this section.

L. Refer to other Division-23 sections for system commissioning, testing and balancing; not work of this section.

1.3 QUALITY ASSURANCE:

A. Manufacturer's Qualifications: Firms regularly engaged in manufacture of metal ductwork products of types, materials, and sizes required, whose products have been in satisfactory use in similar service for not less than 5 years.

B. Installer's Qualifications: A firm with at least 3 years of successful installation experience on projects with metal ductwork systems work similar to that required for project.

1. The installer shall have a publicly registered bonding capacity of sufficient amount to cover this work and all other work in progress by the Contractor.

2. All workmen on the project shall carry state licenses as journeymen or apprentice sheet metal workers with additional certification for welders.

1.4 SUBMITTALS:

A. Product Data: Submit manufacturer's technical product data and installation instructions for metal ductwork materials and products.

B. Shop Drawings: Submit scaled layout drawings of metal ductwork and fittings including, but not limited to, duct sizes, locations, elevations, and slopes of horizontal runs, wall and floor penetrations, and connections. Show interface and spacial relationship between ductwork and proximate equipment. Show modifications of indicated requirements, made to conform to local shop practice, and how those modifications ensure that free area, materials, and rigidity are not reduced.

C. Record Drawings: At project closeout, submit record drawings of installed metal ductwork and ductwork products, in accordance with requirements of General Conditions.

D. Maintenance Data: Submit maintenance data and parts lists for metal ductwork materials and products. Include this data, product data, shop drawings, and record drawings in maintenance manual; in accordance with requirements of General Conditions.

1.5 REFERENCES:

A. Codes and Standards:

1. SMACNA Standards: Comply with SMACNA "HVAC Duct Construction Standards, Metal and Flexible" for fabrication and installation of metal ductwork.

2. ASHRAE Standards: Comply with ASHRAE Handbook, Equipment Volume, Chapter 1 "Duct Construction", for fabrication and installation of metal ductwork.

3. NFPA Compliance: Comply with NFPA 90A "Standard for the Installation of Air-Conditioning and Ventilating Systems" and NFPA 90B "Standard for the Installation of Warm Air Heating and Air-Conditioning Systems".

4. International Building Code/International Mechanical Code: Comply with all sections pertaining to mechanical work.

B. Field Reference Manual: Have available for reference at project field office, copy of SMACNA "HVAC Duct Construction Standards, Metal and Flexible".

1.6 DELIVERY, STORAGE, AND HANDLING:

A. Protection: Protect shop-fabricated and factory-fabricated ductwork, accessories and

purchased products from damage during shipping, storage and handling. Prevent end damage and prevent dirt and moisture from entering ducts and fittings.

B. Storage: Where possible, store ductwork inside and protect from weather. Where necessary to store outside, store above grade and enclosed with waterproof wrapping.

PART II - PRODUCTS

2.1 DUCTWORK - GENERAL:

A. Standards: All duct fabrications shall comply with standards and techniques detailed by SMACNA "Duct Construction Manuals" for the appropriate pressure class, and with the ASHRAE Handbook, 1988 edition, Chapter 1, Duct Construction

B. Sheet Metal: Except as otherwise indicated, fabricate ductwork from galvanized sheet steel complying with ASTM A 527, lockforming quality, with G 90 zinc coating in accordance with ASTM A 525; mill phosphatized for exposed locations.

C. Exposed Ductwork Materials: Where ductwork is indicated to be exposed to view in occupied spaces, provide materials which are free from visual imperfections including pitting, seam marks, roller marks, stains and discolorations, and other imperfections, including those which would impair painting. Installation of exposed ductwork shall be laid out in advance and submitted for review. Ductwork shall be hung straight and uniform, points shall be true, seams shall show continuity.

D. Stainless Steel Assemblies: Fabricate of Type 304 SS or Type 316 SS stainless steel sheet complying with ASTM A-167 with all welded joints and seams. Provide polished No. 4 satin finish for all hoods and duct exposed to view, No. 1 finish elsewhere. Protect finished surfaces with mill applied adhesive protective paper through fabrication and installation.

2.2 FITTINGS AND FABRICATION:

A. Fittings: Provide radius type fittings fabricated of multiple sections with maximum 15^{o} change of direction per section. Unless specifically detailed otherwise, use 45^{o} lateral and 45^{o} elbows for branch take-off connections. Where 90^{o} branches are indicated, provide conical type tees.

B. Fabricate duct fittings to match adjoining ducts, and to comply with duct requirements as applicable to fittings. Except as otherwise indicated, fabricate elbows with center-line radius equal to associated duct width; and fabricate to include turning vanes in elbows where shorter radius is necessary. Limit angular tapers to 30^{o} for contracting tapers and 20^{o} for expanding tapers.

C. Fabricate ductwork with accessories installed during fabrication to the greatest extent possible. Refer to Division-23 section "Duct Accessories' for accessory requirements.

D. Fabricate ductwork with duct liner in each section of duct where indicated. Laminate liner to internal surfaces of duct in accordance with instructions by manufacturers of lining and adhesive, and fasten with mechanical fasteners.

E. Offset, transition, adapt ductwork to structural obstacles and work of other trades in a coordinated effort. Layout work to avoid conflict with piping, etc. With review of conditions, teardrop around conflicting piping, lights, etc., all at no added cost to the owner.

2.3 DUCT PRESSURE CLASSIFICATIONS:

A. Low pressure exhaust ductwork and ventilation systems, which include but are not necessarily limited to exhaust fan systems and ventilation systems.

1. Low pressure rectangular ductwork, 3" w.g. Increase metal gauge by 2 (i.e., 20 to 18) for all sizes.

2.4 LOW PRESSURE ROUND DUCTWORK: (1" SMACNA Pressure Class)

A. Round type ductwork for use on low velocity supply systems (1200 fpm maximum), low pressure (0.75" maximum duct pressure), shall be fabricated on 26 gauge galvanized steel sheets with snap-lock longitudinal seams and crimped and beaded joins.

B. All end joints shall have at least three screw fasteners and shall be wrapped airtight. Transverse and longitudinal seams shall be taped with "Hardcast TA". Elbows and fittings shall provide smooth air flow patterns and have a neat appearance.

C. Use factory fabricated elbows of the multi-sectional adjustable type.

D. Use aluminum duct in swimming pool spaces and systems.

2.5 LOW PRESSURE RECTANGULAR DUCTWORK: (3" SMACNA Pressure Class)

A. Rectangular ductwork for use on supply systems up to 2" maximum duct static pressure and 2000 fpm maximum duct velocity shall be constructed of galvanized steel using construction for nominal 3" SMACNA rated systems. Seal all transverse joints with duct cement or tape with "Hardcast TA".

B. Use radius elbows or turning vanes with extended trailing edge. Use a true 1-1/2 time 45^{o} tapping takeoffs with downstream balance damper.

C. Duct dimensions are inside clear. Increase for acoustical lining.

D. For rectangular exhaust ducts, increase metal gauge by 2 (i.e. 20 to 18) for all sizes. Seal all joints.

E. Use aluminum duct in swimming pool spaces and systems.

2.6 FACTORY DUCT:

A. Extent of Work: Provide factory duct at connections to air terminal units, at runouts to grilles and diffusers, at points of round to round flexible connections (see also "Flexible Connections") and at other locations indicated or required.

B. Prohibited Material: Do not use single wire helix ducting with vinyl or plastic liner of any type.

C. Factory Duct Non-corrosive Environments: Woven fiberglass fabric impregnated with vinyl or neoprene clamped in a continual helix of aluminum or cold rolled steel. U.L. listed for Class 1 duct, compliant with NFPA 90A and 90B, pressure rated to 12" w.g., equivalent to:

D. Non-insulated: Wiremold 57; Flexmaster Type N145

E. Insulated: Flexmaster Type 4; Thermaflex M-KC

F. Installation: Follow manufacturers instructions. Use stainless steel or nylon band clamping rings. In general, do not use lengths in excess of 3 feet. Make bends only in long radius format. Support duct to avoid droops and kinks.

2.7 MISCELLANEOUS DUCTWORK MATERIALS:

A. General: Provide miscellaneous materials and products of types and sizes indicated and, where not otherwise indicated, provide type and size required to comply with ductwork system requirements including proper connection of ductwork and equipment.

B. Runout Fittings: Runout fittings shall be used to make round to rectangular duct connections. Use 45^{o} time and a half square to round fittings. Provide with locking quadrant dampers where balance is involved. Provide with insulation guard where insulated duct is involved.

C. Duct Sealing Compound: Duct sealing compound shall be 3M brand number EC-750 or Duro-Dyne S-2. This material shall be used in making up duct joints or in water proofing, caulking plenums, etc.

D. Acoustical Lining: Acoustical lining in ducts shall be 1" thick, 1-1/2 pound density, coated, flexible glass fiber type, set in adhesive and impaled on weld studs spaced not more than 12" on centers and secured with lock washers. Airstream surface faced with black coated matte. Acoustical lining shall completely line the ducts. Lining shall have a fire and smoke hazard rating not exceeding 20-50-50. Owens-Corning, Johns-Manville, Certainteed.

E. All joints, edges and/or surface breaks in the coating of the acoustical lining shall be pointed up to a smooth surface with adhesive.

F. Duct Liner Adhesive: Comply with ASTM C 916 "Specifications for Adhesives and Duct Thermal Insulation".

G. Duct Liner Fasteners: Comply with SMACNA HVAC Duct Construction Standards, Article S2.11.

H. Duct Cement: Non-hardening migrating mastic or liquid neoprene based cement (type applicable for fabrication/ installation detail) as compounded and recommended by manufacturer specifically for cementing fitting components, or longitudinal seams in ductwork.

I. Ductwork Support Materials: Except as otherwise indicated, provide hot-dipped galvanized steel fasteners, anchors, rods, straps, trim and angles for support of ductwork.

2.8 AUXILIARY DRAIN PANS:

A. Extent of Work: Where a equipment cooling coil or duct mounted coil providing a cooling function is mounted in a ceiling plenum or other furred space, or under the emergency generator ventilation duct, provide a secondary drain. This may be an overflow drain connection or a corrosion resistant, water-tight drain pan either with drain line extended to a point of visible discharge. (Reference UMC Section 310, 1994 ed.)

B. Construct drain pan of 304 stainless steel with overlapped and soldered corners, with 1" Type M copper tube drain line. Provide long radius bends with cleanout plugs at each change in direction. Provide cleanouts every 20 feet or less with “wye” pattern fittings.

PART III - EXECUTION

3.1 INSPECTION:

A. General: Examine areas and conditions under which metal ductwork is to be installed. Do not proceed with work until unsatisfactory conditions have been corrected in a manner acceptable to Installer.

3.2 INSTALLATION OF METAL DUCTWORK:

A. General: Assemble and install ductwork in accordance with recognized industry practices which will achieve air tight (5% leakage for systems rated 3" and under; 1% for systems rated over 3") and noiseless (no objectionable noise) systems, capable of performing each indicated service. Install each run with minimum number of joints. Align ductwork accurately at connections, within 1/8" misalignment tolerance and with internal surfaces smooth. Support ducts rigidly with suitable ties, braces, hangers and anchors of type which will hold ducts true-to-shape and to prevent buckling. Support vertical ducts at every floor.

All necessary allowance and provisions shall be made in the installation of sheet metal ducts for the structural conditions of the building, and ducts shall be transformed or divided as may be required. Whenever this is necessary, the required area shall be maintained. All of these changes, however, must be approved and installed as directed at project. During the installation, the open ends of ducts shall be protected to prevent debris and dirt from entering.

B. Field Fabrication: Complete fabrication of work at project as necessary to match shop-fabricated work and accommodate installation requirements.

C. Routing: Locate ductwork runs, except as otherwise indicated, vertically and horizontally and avoid diagonal runs wherever possible. Locate runs as indicated by diagrams, details and notations or, if not otherwise indicated, run ductwork in shortest route which does not obstruct usable space or block access for servicing building and its equipment. Hold ducts close to walls, overhead construction, columns, and other structural and permanent-enclosure elements of building. Limit clearance to 1/2" where furring is shown for enclosure or concealment of ducts, but allow for insulation thickness, if any. Where possible, locate insulated ductwork for 1" clearance outside of insulation. Wherever possible in finished and occupied spaces, conceal ductwork from view, by locating in mechanical shafts, hollow wall construction or above suspended ceilings. Do not encase horizontal runs in solid partitions, except as specifically shown. Coordinate layout with suspended ceiling and lighting layouts and similar finished work.

D. Electrical Equipment Spaces: Do not run ductwork through transformer vaults and other electrical equipment spaces and enclosures. Maintain clearances above of and in front of electrical panels.

E. Penetrations: Where ducts pass through interior partitions and exterior walls, and are exposed to view, conceal space between construction opening and duct or duct insulation with sheet metal flanges of same gage as duct. Overlap opening on 4 sides by at least 1-1/2". Fasten to duct and substrate.

1. Where ducts pass through fire-rated floors, walls, or partitions, provide firestopping between duct and substrate, in accordance with requirements of Section "Firestopping".

F. Ducts At Structural and Architectural Penetrations: Where ducts are shown connecting to or passing through concrete, gypsum board, masonry openings and along edges of all plenums at floors and walls, provide a continuous 2" x 2-1/8" galvanized angle iron which shall be bolted to the construction and made airtight to the same by applying caulking compound. Sheet metal in these locations shall be bolted to the angle iron. Round high velocity ducts in vertical chases shall be supported with rolled angle rings. Close openings between duct and structure.

G. Cross Breaking: Rectangular sheet metal ducts shall be cross broken on the four sides of each 4-foot panel. All vertical and horizontal sheet metal barriers, duct offsets, elbows, as well as 4-foot panels of straight sections of ducts shall be cross broken. Cross breaking shall be applied to the sheet metal between the standing seams or reinforcing angles; the center of cross break shall be of the required height to assure surfaces being rigid.

H. Coordination: Coordinate duct installations with installation of accessories, dampers, coil frames, equipment, controls and other associated work of ductwork system.

I. Installation: Install metal ductwork in accordance with SMACNA HVAC Duct Construction Standards.

1. Related to final installation cleanliness, damp wipe all ductwork on installation. Cap open duct ends, cover fan inlets, vacuum fan plenums and related installation before starting fans. Run fans only with filters in place.

3.3 INSTALLATION OF DUCT LINER:

A. General: Install duct liner in accordance with SMACNA HVAC Duct Construction Standards.

As indicated on the drawings, supply, return and exhaust air ductwork shall be lined with acoustical insulation.

In all cases outside air ductwork shall be lined with 2' thick 1-1/2 lb. density acoustical lining unless indicated differently on drawings, ie. requiring Type 2 plenum.

3.4 INSTALLATION OF FLEXIBLE DUCTS:

A. Maximum Length: For any duct run using flexible ductwork, do not exceed 3'-0" extended length. No elbows allowed.

B. Installation: Install in accordance with Section III of SMACNA's "HVAC Duct Construction Standards, Metal and Flexible".

3.5 HANGERS AND SUPPORTS:

A. It is essential that all ducts shall be rigidly supported. Hangers for low velocity ducts up to 18" in width shall be placed on not more than 10' centers.

Low velocity ducts 19" through 35" in width and greater shall be supported on not more than 5' centers. Where vertical ducts pass through floors or roofs, heavy supporting angles shall be attached to ducts, and to structure. Angles shall be of sufficient size to support the ductwork rigidly and shall be placed on at least two sides of the duct.

B. Construct hangers for rectangular ductwork from galvanized iron l" x 1/16". Hangers shall extend down the sides of rectangular ducts the full depth of the duct and shall be bent underneath the duct 2". Hangers shall be secured to the duct using sheet metal screws or rivets of appropriate sizes on 6" centers, but not less than two screws in the side and one in the bottom of each hanger.

C. For rectangular ducts 36" and greater in width construct hangers from galvanized iron 1-1/2" x 1/16". Hangers shall be installed and secured to duct as described in Paragraph B.

3.6 SUPPORTING DAMPERS: Parallel and opposed blade motor operated dampers shall be supported by reinforcing the ductwork or sheet metal walls at the damper locations to carry the weight of the dampers and the force exerted on the dampers due to air pressure, or shall be supported independent of ductwork from the ceiling or floor, as conditions at the site determine.

3.7 CONNECTIONS: Connections of high velocity supply and exhaust ducts, fittings, and high velocity mixing boxes shall be made airtight by coating joints with Minnesota Mining Co. Mastic, Type EC-800, Benjamin Foster, Sheet Metal Products Co., or approved equal, before joining, and then sealing the joint with one layer of "Glass-Fab" reinforcing tape set in a coating of the above compound. Tape and sealant shall not exceed a flame spread of 25 or a smoke development of 50.

3.8 WELDED JOINTS: Welded ductwork shall have either an angle or a piece of 1/8" steel bar behind each weld to allow laying of a neat and continuous bead.

3.9 AESTHETIC LAYOUTS: Contractor shall locate all diffusers, grilles and other exposed items in such a manner as to fit symmetrically in any grid system or other aesthetic architectural or lighting pattern. Refer to reflected ceiling plans and electrical lighting layouts for additional information. Provide duct offsets or extensions as required to make a proper installation.

Close or cap all duct ends. Use auxiliary blower with air flow meter to establish a duct pressure equivalent to the duct pressure class. Inspect all joints in duct system and seal all identifiable leaks.

3.10 FIELD QUALITY CONTROL:

A. Leakage Tests: After each duct system which is constructed for duct classes over 3" is completed, test for duct leakage in accordance with SMACNA HVAC Air Duct Leakage Test Manual. Air leaks which are in excess of that required to bubble the soap suds (that

is, actually blow the suds away) shall be sealed by additional taping and caulking to reduce the leakage to a rate not to exceed slow bubbles forming. Repair leaks and repeat tests until total leakage conforms with Chart of Figure 4-1, Seal Class A, Leakage Class 3 for round/oval, 6 for rectangular.

3.11 EQUIPMENT CONNECTION:

A. General: Connect metal ductwork to equipment as indicated, provide flexible connection for each ductwork connection to equipment mounted on vibration isolators, and/or equipment containing rotating machinery. Provide access doors as indicated.

3.12 ADJUSTING AND CLEANING:

A. Clean ductwork internally of dust and debris, as follows: Before the ceilings are installed, with filters in place, operate the fans at full capacity to blow out dirt and debris from ducts. If it is not practical to use the main supply blower for this test, the ducts may be blown out in sections by a portable fan.

B. Clean external surfaces of foreign substances which might cause corrosive deterioration of metal or, where ductwork is to be painted, might interfere with painting or cause paint deterioration.

C. Balancing:

1. Refer to Division-23 section "Testing, Adjusting, and Balancing" for air distribution balancing of metal ductwork; not work of this section. However, the Sheet Metal Contractor shall participate fully in this work. Seal any leaks in ductwork that become apparent in balancing process.

2. If specified conditions cannot be obtained due to deficiencies in equipment performance or improper installation or workmanship, the Mechanical Contractor and his subcontractors shall make any changes necessary to obtain the specified conditions.

END OF SECTION 233100

SECTION 233300 - DUCTWORK ACCESSORIES

PART I - 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. Division-23 Basic Mechanical Materials and Methods sections apply to work of this section.

1.2 SUMMARY:

A. Extent of ductwork accessories work is indicated on drawings and in schedules, and by requirements of this section.

B. Types of ductwork accessories required for project include the following:

1. Dampers.
    a. Low pressure manual dampers.
    b. Control dampers.
2. Turning vanes.
3. Duct hardware.
4. Duct access doors.
5. Flexible connections.

C. Refer to other Division-23 sections for testing, adjusting, and balancing of ductwork accessories; not work of this section.

1.3 QUALITY ASSURANCE:

A. Manufacturer's Qualifications: Firms regularly engaged in manufacture of ductwork accessories, of types and sizes required, whose products have been in satisfactory use in similar service for not less than 3 years.

1.4 SUBMITTALS:

A. Product Data: Submit manufacturer's technical product data for each type of ductwork accessory, including dimensions, capacities, and materials of construction; and installation instructions.

B. Shop Drawings: Submit manufacturer's assembly-type shop drawings for each type of ductwork accessory showing interfacing requirements with ductwork, method of fastening or support, and methods of assembly of components.

C. Maintenance Data: Submit manufacturer's maintenance data including parts lists for each type of duct accessory. Include this data, product data, and shop drawings in maintenance manual; in accordance with requirements of General Conditions.

1.5 REFERENCES:

A. Codes and Standards:

1. SMACNA Compliance: Comply with applicable portions of SMACNA "HVAC Duct Construction Standards, Metal and Flexible".

2. Industry Standards: Comply with ASHRAE recommendations pertaining to construction of ductwork accessories, except as otherwise indicated.

3. UL Compliance: Construct, test, and label fire dampers in accordance with UL Standard 555 "Fire Dampers and Ceiling Dampers".

4. NFPA Compliance: Comply with applicable provisions of NFPA 90A "Air Conditioning and Ventilating Systems", pertaining to installation of ductwork accessories.

1.6 DELIVERY, STORAGE AND HANDLING:

A. Protection: Protect shop-fabricated and factory-fabricated accessories and purchased products from damage during shipping, storage and handling. Prevent end damage and prevent dirt and moisture from entering ducts and fittings.

B. Storage: Where possible, store accessories inside and protect from weather. Where necessary to store outside, store above grade and enclosed with waterproof wrapping.

PART II - PRODUCTS

2.1 DAMPERS:

A. Control dampers are furnished by this Section and installed by this Section. Dampers shall be supported, plenum openings shall be reinforced, the entire assembly shall be sturdy and operate smoothly. Install dampers to direct outside and return air into each other for mixing. Control dampers for relief air, return air, ventilation air, exhaust air, outside air, and supply air. Low leakage type with spring loaded side seals, inflatable butyl or neoprene fabric edge seals, bronze or teflon bearings, reinforced extruded aluminum airfoil blades, aluminum frame. Action as indicated on drawings. Air leakage not to exceed 5 CFM per square foot at 4" upstream static pressure.

1. Ruskin CD-50
2. Greenheck VCD-43
3. Pottorff
4. Arrow

B. Control dampers for balance only where tight shutoff is not critical are to be furnished and installed by this Section. 6" galvanized blade, poly foam blade seals, flexible metal jamb. Parallel blade operation.

1. Ruskin CD-35
2. Greenheck

3. Pottorff
4. Arrow

2.2 TURNING VANES: Turning vanes shall be installed in all square elbows. Turning vanes shall be single blade. Turning vane spacing shall be per SMACNA. Each blade shall be tack welded or crimped to the carrier frame to prevent rattling.

2.3 DUCT HARDWARE:

A. General: Provide duct hardware, manufactured by one manufacturer for all items on project, for the following:

1. Test Holes: Provide in ductwork at fan inlet and outlet, and elsewhere as indicated, duct test holes, cover, for instrument tests. Ventlok No. 699 closures shall be provided and installed for each test hole, with sufficient neck length to penetrate the insulation.

2. Quadrant Locks: Provide for each damper, quadrant lock device on one end of shaft; and end bearing plate on other end for damper lengths over 12". Provide extended quadrant locks and end extended bearing plates for externally insulated ductwork. (Bare duct - Ventlok 620, 635; Insulated duct - Ventlok 627, 628, 637, 638, 629.)

B. Manufacturer: Subject to compliance with requirements, provide duct hardware of one of the following:

1. Ventfabrics, Inc.
2. Young Regulator Co.

2.4 DUCT ACCESS DOORS: Doors shall be 2" narrower than the duct width by 24" up to a maximum of 24" x 24". Duct access doors shall be furnished for all fire damper links, manual controllers and adjustable balancing devices. Duct access doors for all ductwork (except low pressure ductwork) shall be: Bolted access door, oval shaped constructed of an outer door connected to a an inner plate by spring loaded carriage bolts with wing handles. Inner plate to have cellular spounge gasket for leak free operation up to 20"wg. The door shall have permanently bonded polyester insulation.

2.5 WALL AND CEILING ACCESS DOORS: Wall and ceiling doors at fire dampers and smoke dampers shall be the same as specified in Section 230000. Doors shall be sized for easy access to fire links and not less than 24" x 24" where possible.

2.6 FLEXIBLE CONNECTIONS:

A. Extent of Work: Provide flexible connections between ductwork or plenums and equipment, such as at fan inlets and discharges, and at other places indicated on the drawings or called for by note or specification.

B. Non-Corrosive Environment or Airstream: Provide material of heavy waterproof woven glass fabric double coated with neoprene or hypalon equivalent to “Ventglas” for interior locations and “Ventlon” for exterior locations, fabric not less than 3-1/4" wide clamped between strips of 24 gauge galvanized iron. Material by Ventfabrics, Inc., Chicago, Ill.

PART III - EXECUTION

3.1 INSPECTION:

A. Examine areas and conditions under which ductwork accessories will be installed. Do not proceed with work until unsatisfactory conditions have been corrected in manner acceptable to Installer.

3.2 INSTALLATION OF DUCTWORK ACCESSORIES:

A. Install ductwork accessories in accordance with manufacturer's installation instructions, with applicable portions of details of construction as shown in SMACNA standards, and in accordance with recognized industry practices to ensure that products serve intended function.

B. Install hand operated volume dampers at locations and of sizes shown. Volume dampers shall be controlled by heavy duty locking quadrants mounted on the outside of the duct. Where ducts are insulated, the damper rod shall be extended and the operator shall be mounted on the outside of the insulation. Butterfly dampers may be constructed by the Sheet Metal Contractor. All multi-blade hand dampers shall be the product of one of the manufacturers listed in the Contract Documents. All operator fittings shall be heavy duty commercial grade.

C. Install turning vanes in square or rectangular 90 degree elbows in supply and exhaust air systems, and elsewhere as indicated.

D. Install access doors to open against system air pressure, with latches operable from either side, except outside only where duct is to small for person to enter.

E. Coordinate with other work, including ductwork, as necessary to interface installation of ductwork accessories properly with other work.

3.3 FIELD QUALITY CONTROL:

A. Operate installed ductwork accessories to demonstrate compliance with requirements. Test for air leakage while system is operating. Repair or replace faulty accessories, as required to obtain proper operation and leakproof performance.

3.4 ADJUSTING AND CLEANING:

A. Adjusting: Adjust ductwork accessories for proper settings, install fusible links in fire dampers and adjust for proper action.

1. Label access doors in accordance with Division-23 section "Mechanical Identification".

2. Final positioning of manual dampers is specified in Division- 23 section "Testing, Adjusting, and Balancing".

3. Cleaning: Clean factory-finished surfaces. Repair any marred or scratched surfaces with manufacturer's touch-up paint.

3.5 EXTRA STOCK:

A. Furnish extra fusible links to Owner, one link for every 10 installed of each temperature range; obtain receipt.

END OF SECTION 233300

SECTION 233423 - POWER VENTILATORS

PART I - 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. Division-23 General Mechanical Requirements sections apply to work of this section.

C. See Section 230513 Motors, Drives and Electrical Requirements for Mechanical Work.

1.2 SUMMARY:

A. Extent of power and gravity ventilator work required by this section is indicated on drawings and schedules, and by requirements of this section.

B. Types of power and gravity ventilators specified in this section include the following:

1. Power ventilators.

a. Ceiling Exhaust Fans

C. Refer to Division-23 section "System Commissioning, Testing and Balancing" for balancing of power and gravity ventilators; not work of this section.

D. Refer to Division-23 temperature control systems sections for control work required in conjunction with power and gravity ventilators; not work of this section.

E. Refer to Division-26 sections for the following work; not work of this section.

1. Power supply wiring from power source to power connection on ventilators. Include starters, disconnects, and required electrical devices, except where specified as furnished, or factory-installed, by manufacturer.

2. Interlock wiring between ventilators; and between ventilators and field-installed control devices as shown in Division 26.

a. Interlock wiring specified as factory-installed is work of this section.

1.3 QUALITY ASSURANCE:

A. Manufacturer's Qualifications: Firms regularly engaged in manufacture of power and gravity ventilators, of types and sizes required, whose products have been in satisfactory use in similar service for not less than 5 years.

1.4 SUBMITTALS:

A. Product Data: Submit manufacturer's technical data for power and gravity ventilators, including specifications, capacity ratings, dimensions, weights, materials, accessories furnished, and installation instructions.

B. Shop Drawings: Submit assembly-type shop drawings showing unit dimensions, construction details, methods of assembly of components, and field connection details.

C. Wiring Diagrams: Submit manufacturer's electrical requirements for power supply wiring to power ventilators. Submit manufacturer's ladder-type wiring diagrams for interlock and control wiring. Clearly differentiate between portions of wiring that are factory-installed and portions to be field-installed.

D. Maintenance Data: Submit maintenance data and parts list for each type of power and gravity ventilator, accessory, and control. Include this data, product data, shop drawings, and wiring diagrams in maintenance manual; in accordance with requirements of Division 23.

1.5 REFERENCES:

A. Codes and Standards:

1. AMCA Compliance: Provide power ventilators which have been tested and rated in accordance with AMCA standards, and bear AMCA Certified Rating Seal.

2. UL Compliance: Provide power ventilators which are listed by UL and have UL label affixed.

3. NEMA Compliance: Provide motors and electrical accessories complying with NEMA standards.

PART II - PRODUCTS

2.1 CEILING EXHAUST FANS (CEF):

A. Ceiling mounted fans shall have acoustically insulated housings and shall have a maximum sound level rating of 4.6 sones. Fans shall bear the AMCA seal and the UL label. Integral backdraft damper shall be totally chatterproof with no metal to metal contact. Fans shall have true centrifugal wheels. Entire fan, motor and wheel assembly shall be easily removable without disturbing the housing. All motors shall be suitably grounded and mounted on rubber in shear vibration isolators. Hang fan from structure on metal bands. The fan shall turn on as noted.

B. Manufacturer: Subject to compliance with requirements, provide inline fans of one of the following:

1. Cook.
2. Penn Zephyr.
3. Greenheck.
4. Twin City

PART III - EXECUTION

3.1 INSPECTION:

A. General: Examine areas and conditions under which power and gravity ventilators are to

be installed. Do not proceed with work until unsatisfactory conditions have been corrected.

3.2 INSTALLATION OF POWER VENTILATORS:

A. General: Except as otherwise indicated or specified, install power ventilators in accordance with manufacturer's installation instructions and recognized industry practices to insure that products serve the intended function.

B. Coordinate ventilator work with work of walls, roof and ceilings, as necessary for proper interfacing.

C. Ductwork: Refer to Division-23 section "Ductwork." Connect ducts to ventilators in accordance with manufacturer's installation instructions.

D. Electrical Wiring: Install electrical devices furnished by manufacturer but not specified to be factory-mounted.

E. Remove shipping bolts and temporary supports within ventilators. Adjust dampers for free operation.

F. Hang from or install on spring type vibration isolators, complete with appropriate mounting frame.

3.3 FIELD QUALITY CONTROL:

A. Testing: After installation ventilators has been completed, test each ventilator to demonstrate proper operation of unit at performance requirements specified. When possible, field correct malfunctioning units, then retest to demonstrate compliance. Replace units which cannot be satisfactorily corrected.

3.4 ADJUSTING AND CLEANING:

A. Cleaning: Clean factory-finished surfaces. Repair any marred or scratched surfaces with manufacturer's touch-up paint.

END OF SECTION 233423

SECTION 233713 - AIR OUTLETS AND INLETS

PART I - 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.

1.2 SUMMARY:

A. Extent of air outlets and inlets work is indicated by drawings and schedules, and by requirements of this section.

B. Types of outlets and inlets required for project include the following:

1. Ceiling air diffusers and grilles.
2. Wall registers and grilles.
3. Gravity Ventilation Hoods.

C. Refer to other Division-23 sections for ductwork and duct accessories required in conjunction with air outlets and inlets; not work of this section.

D. Refer to other Division-23 sections for balancing of air outlets and inlets; not work of this section.

E. Refer to other Division sections for louvers, not work of this section.

1.3 QUALITY ASSURANCE:

A. Manufacturer's Qualifications: Firms regularly engaged in manufacture of air outlets and inlets of types and capacities required, whose products have been in satisfactory use in similar service for not less than 5 years.

B. Installer's Qualifications: A firm with at least 3 years of successful installation experience on projects with metal ductwork systems work similar to that required for project.

1. The Installer shall have a publicly registered bonding capacity of sufficient amount to cover this work and all other work in progress by the Contractor.

2. All workmen on the project shall carry state licenses as journeymen or apprentice sheet metal workers with additional certification for welders.

1.4 SUBMITTALS:

A. Product Data: Submit manufacturer's technical product data for air outlets and inlets including the following:

1. Schedule of air outlets and inlets indicating drawing designation, room location, number furnished, model number, size, and accessories furnished.

2. Data sheet for each type of air outlet and inlet, and accessory furnished; indicating construction, finish, and mounting details.

3. Performance data for each type of air outlet and inlet furnished, including aspiration ability, temperature and velocity traverses; throw and drop; and noise criteria ratings. Indicate selections on data.

B. Samples: 3 samples of each type of finish furnished.

C. Shop Drawings: Submit manufacturer's assembly-type shop drawing for each type of air outlet and inlet, indicating materials and methods of assembly of components.

D. Maintenance Data: Submit maintenance data, including cleaning instructions for finishes, and spare parts lists. Include this data, product data, and shop drawings in maintenance manuals; in accordance with requirements of General Conditions.

1.5 REFERENCES:

A. Codes and Standards:

1. ARI Compliance: Test and rate air outlets and inlets in accordance with ARI 650 "Standard for Air Outlets and Inlets".

2. ASHRAE Compliance: Test and rate air outlets and inlets in accordance with ASHRAE 70 "Method of Testing for Rating the Air Flow Performance of Outlets and Inlets".

3. AMCA Compliance: Test and rate louvers in accordance with AMCA 500 "Test Method for Louvers, Dampers and Shutters".

4. AMCA Seal: Provide louvers bearing AMCA Certified Rating Seal.

5. NFPA Compliance: Install air outlets and inlets in accordance with NFPA 90A "Standard for the Installation of Air Conditioning and Ventilating Systems".

1.6 PRODUCT DELIVERY, STORAGE AND HANDLING:

A. Deliver air outlets and inlets wrapped in factory-fabricated fiber-board type containers. Identify on outside of container type of outlet or inlet and location to be installed. Avoid crushing or bending and prevent dirt and debris from entering and settling in devices.

B. Store air outlets and inlets in original cartons and protect from weather and construction work traffic. Where possible, store indoors; when necessary to store outdoors, store above grade and enclose with waterproof wrapping.

PART II - PRODUCTS

2.1 GRILLES AND DIFFUSERS:

A. General: Except as otherwise indicated, provide manufacturer's standard ceiling air diffusers where shown; of size, shape, capacity and type indicated; constructed of materials and components as indicated, and as required for complete installation.

B. Performance: Provide ceiling air diffusers that have, as minimum, temperature and velocity traverses, throw and drop, and noise criteria ratings for each size device as listed in manufacturer's current data.

C. Ceiling Compatibility: Provide diffusers with border styles that are compatible with adjacent ceiling systems, and that are specifically manufactured to fit into ceiling module with accurate fit and adequate support. Refer to general construction drawings and specifications for types of ceiling systems which will contain each type of ceiling air diffuser.

D. Adjust all grilles and diffusers to fit neatly in the room ceiling pattern. Set final locations per architectural reflected ceiling plans.

E. Volume Control Dampers: Provide duct mounted dampers of the externally adjustable opposed blade type where more than one grille or register is on a common duct. Provide access to each damper adjustment.

F. Sound Level: The diffuser or grille generated noise shall not exceed the following sound power level curve at a point five feet away form the diffuser or grille.

1. Meeting Rooms: Classrooms: NC 30-35
2. Office Areas: NC 30-35
3. Studios and Sound Sensitive Rooms: NC-20-25
4. Work Rooms: NC 35-40
5. Storage: NC 35-40

G. Manufacturers: Subject to compliance with requirements, provide grilles and diffusers of one of the following:

1. Krueger
2. Titus
3. EH Price

H. Types: Provide grilles and diffusers of type, capacity, and with accessories and finishes as listed on grille and diffuser schedule and as specified herein.

I. Grilles and Diffusers:

1. Ceiling Supply Diffuser (S-1): Krueger Series 1400, square face, round neck, four-way deflection, anti-smudge design, removable inner core, all steel construction, appropriate mounting frame, white baked enamel finish, size as indicated on drawings.

2. Ceiling Supply Diffuser (S-2): Krueger Series SH, square face, one, two, three or four way blow as required. Square neck, anti-smudge border, all steel, white baked on enamel, size as indicated on drawings.

3. Linear Slot Supply Diffuser (S-3): Krueger Series DFL15, extruded aluminum construction 1-1/2” slot, slot length adjustable, standard British White finish, size as indicated on drawings.

4. Sidewall Supply Register (S-4): Krueger Series AF880 aluminum construction with steel frame, adjustable, double deflection airfoil blades, 3/4" blade spacing, appropriate mounting frame, sponge rubber gasket, baked enamel finish, standard British White finish, size as indicated on drawings.

5. Heavy Duty Bar Return Grille (R-1): Krueger Series S480, 38-degree blade deflection, heavy duty grille, steel construction, standard British White finish, size as indicated on drawings.

6. Perforated Return Register (R-2, R-3, R-4): Krueger Series 6490. Steel face and backpan construction, square neck, concealed hinge frame, sponge rubber gasket, white baked-on enamel, size as indicated on drawing.

7. Sidewall Return Register (R-5): Krueger Series AFCS85. Steel construction, horizontal or vertical blades with 1/2" spacing, optional damper and filter, appropriate mounting frame, sponge rubber gasket, baked enamel finish, color selected by Architect, size as indicated on drawings.

2.2 GRAVITY VENTILATION HOODS (GVH):

1. Gravity Roof Ventilator (GVH-1); Cook Series GR. Roof Curb Mount, interlocking seam hood panels, bases manufactured with rounded flange around throat, integral lifting lugs, hinged hood and rain gutters standard, sized as indicated on drawings.

2. Spun Relief Ventilator (GVH-2): Cook Series PR, round throat, aluminum construction, compact, durable, bases manufactured with fully developed inlet, weather resistant, size as indicated on drawings.

PART III - EXECUTION

3.1 INSPECTION:

A. Examine areas and conditions under which air outlets and inlets are to be installed. Do not proceed with work until unsatisfactory conditions have been corrected.

3.2 INSTALLATION:

A. General: Install air outlets and inlets in accordance with manufacturer's written instructions and in accordance with recognized industry practices to insure that products serve intended function.

B. Coordinate with other work, including ductwork and duct accessories, as necessary to interface installation of air outlets and inlets with other work.

C. Locate ceiling air diffusers, registers, and grilles, as indicated on general construction "Reflected Ceiling Plans". Unless otherwise indicated, locate units in center of acoustical ceiling module.

END OF SECTION 233713

SECTION 237350 - PACKAGED ROOFTOP UNITS

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. Division-23 General Mechanical Requirements, and General Pipes and Fittings sections apply to work of this section.

1.2 SUMMARY:

A. Extent of rooftop unit work is indicated on drawings, schedules, and by requirements of this section.

B. Types of packaged air-handling units specified in this section include the following:

1. Rooftop units.

C. Refer to Division-26 sections for the following work.

1. Power supply wiring from power source to power connection on unit. Include starters, disconnects, and required electrical devices, except where specified as furnished, or factory-installed.

1.3 QUALITY ASSURANCE:

A. Manufacturer's Qualifications: Firms regularly engaged in manufacture of packaged air-handling units with characteristics, sizes, and capacities required, whose products have been in satisfactory use in similar service for not less than 5 years.

B. Installer's Qualifications: A firm with at least 3 years of successful installation experience on projects with metal ductwork systems work similar to that required for project.

C. Fabricate and label refrigeration system to comply with ASHRAE 15, "Safety Code for Mechanical Refrigeration."

D. Energy Efficiency Ratio: Equal to or greater than prescribed by the adopted version of ASHRAE 90.1, "Energy Efficient Design of New Buildings except Low-Rise Residential Buildings."

E. Listing and Labeling: Provide electrically operated components specified in this Section that are listed and labeled.

1.4 SUBMITTALS:

A. Product Data: Submit manufacturer's technical product data for air handling units showing dimensions, weights, capacities, ratings, fan performance with operating point clearly indicated, motor electrical characteristics, gages and finishes of materials, and installation instructions.

B. Shop Drawings: Submit assembly-type shop drawings showing unit dimensions, weight loadings, required clearances, construction details, and field connection details. Detail mounting, securing, and flashing of roof curb to roof structure. Indicate coordinating requirements with roof membrane system.

C. Wiring Diagrams: Submit manufacturer's electrical requirements for power supply wiring to air handling units. Submit manufacturer's ladder-type wiring diagrams for interlock and control wiring. Clearly differentiate between portions of wiring that are factory-installed and portions to be field-installed.

D. Maintenance Data: Submit maintenance instructions, including instructions for lubrication, filter replacement, motor and drive replacement, and spare parts lists. Include this data, product data, shop drawings, and wiring diagrams in maintenance manuals; in accordance with requirements of Division 230100.

1.5 REFERENCES:

A. Codes and Standards:

1. AMCA Compliance: Test and rate air handling units in accordance with AMCA standards.

2. ARI Compliance: Test and rate air handling units in accordance with ARI 430 "Standard for Central-Station Air Handling Units", display certification symbol on units of certified models.

3. ASHRAE Compliance: Construct and install refrigerant coils in accordance with ASHRAE 15 "Safety Code for Mechanical Refrigeration".

4. NFPA Compliance: Provide air handling unit internal insulation having flame spread rating not over 25 and smoke developed rating no higher than 50; and complying with NFPA 90A "Standard for the Installation of Air Conditioning and Ventilating Systems".

5. NEC Compliance: Comply with National Electrical Code (NFPA 70) as applicable to installation and electrical connections of ancillary electrical components of air handling units.

6. International Building Code/International Mechanical Code: Comply with all sections pertaining to mechanical work.

1.6 PRODUCT DELIVERY, STORAGE AND HANDLING:

A. Deliver air-conditioning units with factory-installed shipping skids and lifting lugs; pack components in factory-fabricated protective containers.

B. Handle air-handling units carefully to avoid damage to components, enclosures, and finish. Do not install damaged components; replace and return damaged components to air-handling unit manufacturer.

C. Store air-handling units in clean dry place and protect from weather and construction traffic. Where necessary to store outside, store above grade and enclosed with waterproof wrapping.

D. Comply with Manufacturer's rigging and installation instructions for unloading air handling units, and moving them to final location.

1.06 COORDINATION

A. Coordinate installation of roof curbs and roof penetrations with roof construction.

PART 2 - PRODUCTS

2.1 ROOFTOP UNITS:

A. Description: Factory assembled and tested; designed for roof installation; and consisting of compressors, condensers, evaporator coils, condenser and evaporator fans, gas heater, filters, dampers and factory installed digital controls.

B. Approved Manufacturers:

1. Carrier
2. Lennox
3. Trane
4. York
5. Aaon
6. Daikin

C. HVAC Equipment Insulation

1. Evaporator fan compartment:

a. Interior cabinet surfaces shall be insulated with a minimum 1/2-in. thick, minimum 1 1/2 lb density, flexible fiberglass insulation bonded with a phenolic binder, neoprene coated on the air side.

b. Insulation and adhesive shall meet NFPA 90A requirements for flame spread and smoke generation.

2. Gas heat compartment:

a. Aluminum foil-faced fiberglass insulation shall be used.

b. Insulation and adhesive shall meet NFPA 90A requirements for flame spread and smoke generation.

D. Instrumentation and Control Devices for HVAC

1. Thermostats: Thermostats must:
   a. energize both “W” and “G” when calling for heat.
   b. have capability to energize 2 stages of cooling, and 2 different stages of heating.
   c. include capability for occupancy scheduling.

E. Electric and Electronic Control System for HVAC

1. General:

   a. Shall be complete with self-contained low-voltage control circuit protected by a resettable circuit breaker on the 24-v transformer side. Transformer shall have 75VA capability.
   b. Shall utilize color-coded wiring.
   c. Shall include a central control terminal board to conveniently and safely provide connection points for vital control functions such as: smoke detectors, phase monitor, gas controller, economizer, thermostat, and low and high pressure switches.
   d. The heat exchanger shall be controlled by an integrated gas controller (IGC) microprocessor. See heat exchanger section of this specification.

2. Safeties:

   a. Compressor over-temperature, over-current. High internal pressure differential.
   b. Low-pressure switch.

      1) Units with 2 compressors shall have different sized connectors for the circuit 1 and circuit 2 low and high pressure switches. They shall physically prevent the cross-wiring of the safety switches between circuits 1 and 2.
      2) Low pressure switch shall use different color wire than the high pressure switch. The purpose is to assist the installer and service technician to correctly wire and or troubleshoot the rooftop unit.

   c. High-pressure switch.

      1) Units with 2 compressors shall have different sized connectors for the circuit 1 and circuit 2 low and high pressure switches. They shall physically prevent the cross-wiring of the safety switches between circuits 1 and 2.
      2) High pressure switch shall use different color wire than the low pressure switch. The purpose is to assist the installer and service technician to correctly wire and or troubleshoot the rooftop unit.

   d. Automatic reset, motor thermal overload protector.

e. Heating section shall be provided with the following minimum protections:

1) High-temperature limit switches.
2) Induced draft motor speed sensor.
3) Flame rollout switch.
4) Flame proving controls.

F. Sequence of Operations for HVAC Controls:

1. Refer to Specification Section 230900, Mechanical Control Systems for unit control sequence.

G. Panel Air Filters:

1. Shall consist of factory-installed, low velocity, disposable 2-in. thick fiberglass filters of commercially available sizes.

2. Unit shall use only one filter size. Multiple sizes are not acceptable.

3. Filters shall be accessible through an access panel with "no-tool" removal as described in the unit cabinet section of this specification.

H. Self-Contained Air Conditioners:

1. General:

a. Outdoor, rooftop mounted, electrically controlled, heating and cooling unit utilizing a fully hermetic scroll compressor(s) for cooling duty and gas combustion for heating duty.
b. Factory assembled, single-piece heating and cooling rooftop unit. Contained within the unit enclosure shall be all factory wiring, piping, controls, and special features required prior to field start-up.
c. Unit shall use environmentally sound, Puron refrigerant.
d. Unit shall be installed in accordance with the manufacturer's instructions.
e. Unit must be selected and installed in compliance with local, state, and federal codes.

2. Quality Assurance

a. Unit meets ASHRAE 90.1 minimum efficiency requirements.
b. 3 phase units are Energy Star certified.
c. Unit shall be rated in accordance with AHRI Standards 210/240 and 340/360.
d. Unit shall be designed to conform to ASHRAE 15, 2001.
e. Unit shall be UL-tested and certified in accordance with ANSI Z21.47 Standards and UL-listed and certified under Canadian standards as a total package for safety requirements.
f. Insulation and adhesive shall meet NFPA 90A requirements for flame

spread and smoke generation.

g. Unit casing shall be capable of withstanding 500-hour salt spray exposure per ASTM B117 (scribed specimen).
h. Unit casing shall be capable of withstanding Federal Test Method Standard No. 141 (Method 6061) 5000-hour salt spray.
i. Unit shall be designed in accordance with ISO 9001:2008, and shall be manufactured in a facility registered by ISO 9001:2008.
j. Roof curb shall be designed to conform to NRCA Standards.
k. Unit shall be subjected to a completely automated run test on the assembly line. The data for each unit will be stored at the factory, and must be available upon request.
l. Unit shall be designed in accordance with UL Standard 1995, including tested to withstand rain.
m. Unit shall be constructed to prevent intrusion of snow and tested to prevent snow intrusion into the control box up to 40 mph.
n. Unit shake tested to assurance level 1, ASTM D4169 to ensure shipping reliability.

3. Delivery, Storage and Handling:

a. Unit shall be stored and handled per manufacturer's recommendations.
b. Lifted by crane requires either shipping top panel or spreader bars.
c. Unit shall only be stored or positioned in the upright position.

4. Operating Characteristics:

a. Unit shall be capable of starting and running at 125°F ambient outdoor temperature, meeting maximum load criteria of AHRI Standard 210/240 or 340/360 at 10% voltage.
b. Accessory low ambient kits shall be provided.

5. Unit Cabinet:

a. Unit cabinet shall be constructed of galvanized steel, and shall be bonderized and coated with a pre-painted baked enamel finish on all externally exposed surfaces.
b. Unit cabinet exterior paint shall be: film thickness, (dry) 0.003 inches minimum, gloss (per ASTM D523, 60°F): 60, Hardness: H-2H Pencil hardness.
c. Evaporator fan compartment interior cabinet insulation shall conform to AHRI Standards 210/240 or 340/360 minimum exterior sweat criteria. Interior surfaces shall be insulated with a minimum 1/2-in. thick, 1 lb density, flexible fiberglass insulation, neoprene coated on the air side. Aluminum foil-faced fiberglass insulation shall be used in the gas heat compartment.
d. Base of unit shall have a minimum of four locations for thru-the-base gas and electrical connections (factory installed or field installed), standard.
e. Base Rail
    1) Unit shall have base rails on a minimum of 4 sides.

2) Holes shall be provided in the base rails for rigging shackles to facilitate maneuvering and overhead rigging.
3) Holes shall be provided in the base rail for moving the rooftop by fork truck.
4) Base rail shall be a minimum of 16 gauge thickness.

f. Condensate pan and connections:

1) Shall be an internally sloped condensate drain pan made of a non-corrosive material.
2) Shall comply with ASHRAE Standard 62.
3) Shall use a 3/4" -14 NPT drain connection, possible either through the bottom or side of the drain pan. Connection shall be made per manufacturer's recommendations.

g. Top panel:

1) Shall be a single piece top panel.

h. Gas Connections:

1) All gas piping connecting to unit gas valve shall enter the unit cabinet at a single location on side of unit (horizontal plane).

i. Electrical Connections

1) All unit power wiring shall enter unit cabinet at a single, factory-prepared, knockout location.
2) Thru-the-base capability.

a) Standard unit shall have a thru-the-base electrical location(s) using a raised, embossed portion of the unit basepan.
b) Optional, factory-approved, water-tight connection method must be used for thru-the-base electrical connections.
c) No basepan penetration, other than those authorized by the manufacturer, is permitted.

j. Component access panels (standard)

1) Cabinet panels shall be easily removable for servicing.
2) Unit shall have one factory installed, tool-less, removable, filter access panel.
3) Panels covering control box, indoor fan, indoor fan motor, gas components (where applicable), and compressors shall have a molded composite handles.
4) Handles shall be UV modified, composite. They shall be permanently attached, and recessed into the panel.
5) Screws on the vertical portion of all removable access panel shall

engage into heat resistant, molded composite collars.

6) Collars shall be removable and easily replaceable using manufacturer recommended parts.

6. Gas Heat

a. General

1) Heat exchanger shall be an induced draft design. Positive pressure heat exchanger designs shall not be allowed.
2) Shall incorporate a direct-spark ignition system and redundant main gas valve.
3) Gas supply pressure at the inlet to the rooftop unit gas valve must match that required by the manufacturer.

b. The heat exchanger shall be controlled by an integrated gas controller (IGC) microprocessor.

1) IGC board shall notify users of fault using an LED (light-emitting diode).
2) The LED shall be visible without removing the control box access panel.
3) IGC board shall contain algorithms that modify evaporator-fan operation to prevent future cycling on high temperature limit switch.
4) Unit shall be equipped with anti-cycle protection with one short cycle on unit flame rollout switch or 4 continuous short cycles on the high temperature limit switch. Fault indication shall be made using an LED.

c. Stainless Steel Heat Exchanger construction:

1) Use energy saving, direct-spark ignition system.
2) Use a redundant main gas valve.
3) Burners shall be of the in-shot type constructed of aluminum-coated steel.
4) All gas piping shall enter the unit cabinet at a single location on side of unit (horizontal plane).
5) The optional stainless steel heat exchanger shall be of the tubular-section type, constructed of a minimum of 20-gauge type 409 stainless steel.
6) Type 409 stainless steel shall be used in heat exchanger tubes and vestibule plate.
7) Complete stainless steel heat exchanger allows for greater application flexibility.

d. Induced draft combustion motor and blower

1) Shall be a direct-drive, single inlet, forward-curved centrifugal

type.
2) Shall be made from steel with a corrosion-resistant finish.
3) Shall have permanently lubricated sealed bearings.
4) Shall have inherent thermal overload protection.
5) Shall have an automatic reset feature.

7. Coils

a. Furnish flue extension to exhaust flue cases above the top of the unit to prevent products of combustion from being drawn into the outside air intake.
b. Standard Aluminum Fin/Copper Tube Coils:

1) Standard evaporator and condenser coils shall have aluminum lanced plate fins mechanically bonded to seamless internally grooved copper tubes with all joints brazed.
2) Evaporator coils shall be leak tested to 150 psig, pressure tested to 450 psig, and qualified to UL 1995 burst test at 1775 psig.
3) Condenser coils shall be leak tested to 150 psig, pressure tested to 650 psig, and qualified to UL 1995 burst test at 1980 psig.

8. Refrigerant Components:

a. Refrigerant circuit shall include the following control, safety, and maintenance features:

1) Thermostatic Expansion Valve (TXV) shall help provide optimum performance across the entire operating range. Shall contain removable power element to allow change out of power element and bulb without removing the valve body.
2) Refrigerant filter drier - Solid core design.
3) Service gauge connections on suction and discharge lines.
4) Pressure gauge access through a specially designed access port in the top panel of the unit.

b. There shall be gauge line access port in the skin of the rooftop, covered by a black, removable plug.

1) The plug shall be easy to remove and replace.
2) When the plug is removed, the gauge access port shall enable maintenance personnel to route their pressure gauge lines.
3) This gauge access port shall facilitate correct and accurate condenser pressure readings by enabling the reading with the compressor access panel on.
4) The plug shall be made of a leak proof, UV-resistant, composite material.

c. Compressors

1) Unit shall use fully hermetic, scroll compressor for each independent refrigeration circuit.
2) Units shall be available with single compressor/single stage cooling.
3) Compressor motors shall be cooled by refrigerant gas passing through motor windings.Compressors shall be internally protected from high discharge temperature conditions.
4) Compressors shall be protected from an over-temperature and over-amperage conditions by an internal, motor overload device.
5) Compressor shall be factory mounted on rubber grommets.
6) Compressor motors shall have internal line break thermal, current overload and high pressure differential protection.
7) Crankcase heaters shall not be required for normal operating range, unless provided by the factory.

9. Filter Section:

a. Filters shall be held in place by a pivoting filter tray, facilitating easy removal and installation.
b. Shall consist of factory-installed, low velocity, throw-away 2-in. thick fiberglass filters.
c. Filters shall be standard, commercially available sizes.
d. Only one size filter per unit is allowed.

10. Evaporator Fan and Motor:

a. Evaporator fan motor:

1) Shall have permanently lubricated bearings.
Shall have inherent automatic-reset thermal overload protection or circuit breaker.
2) Shall have a maximum continuous bhp rating for continuous duty operation; no safety factors above that rating shall be required.

b. Belt-driven Evaporator Fan:

1) Belt drive shall include an adjustable-pitch motor pulley.
2) Shall use sealed, permanently lubricated ball-bearing type.
3) Blower fan shall be double-inlet type with forward-curved blades.
4) Shall be constructed from steel with a corrosion resistant finish and dynamically balanced.

11. Condenser Fan Motors

a. Shall be a totally enclosed motor.
b. Shall use permanently lubricated bearings.
c. Shall have inherent thermal overload protection with an automatic reset feature.

d. Shall use a shaft-down design with rain shield.

e. Condenser Fans:

1) Shall be a direct-driven propeller type fan.
2) Shall have aluminum blades riveted to corrosion-resistant steel spiders and shall be dynamically balanced.

12. Special Features Options and Accessories:

a. Integrated Economizers:

1) Integrated, gear-driven parallel modulating blade design type capable of simultaneous economizer and compressor operation.
2) Damper blades shall be galvanized steel with composite gears. Plastic or composite blades on intake or return shall not be acceptable.
3) Shall include all hardware and controls to provide free cooling with outdoor air when temperature and/or humidity are below setpoints.
4) Shall be equipped with gear driven dampers for both the outdoor ventilation air and the return air for positive air stream control.
5) Shall be equipped with low-leakage dampers, not to exceed 2% leakage at 1 in. wg pressure differential.
6) Shall be capable of introducing up to 100% outdoor air.
7) Shall be designed to close damper(s) during loss-of-power situations with spring return built into motor.
8) Dry bulb outdoor-air temperature sensor shall be provided as standard. Outdoor air sensor setpoint shall be adjustable and shall range from 40 to 100°F.
9) Gravity economizer relief.
10) The economizer shall maintain minimum airflow into the building during occupied period and provide design ventilation rate for full occupancy. A remote potentiometer may be used to override the damper setpoint.
11) Dampers shall be completely closed when the unit is in the unoccupied mode.
12) close closes at 50°F.
13) Actuator shall be direct coupled to economizer gear.
14) Economizer controller shall provide indications when in free cooling mode, in the DCV mode, or the exhaust fan contact is closed.
15) Flue gas extension kit designed to exhaust product of combustion at or above top of unit.

b. Head Pressure Control Package

1) Controller shall control coil head pressure by condenser-fan speed modulation or condenser-fan cycling and wind baffles.
2) Shall consist of solid-state control and condenser-coil temperature

sensor to maintain condensing temperature between 90°F and 110°F at outdoor ambient temperatures down to -20°F.

c. Flue Shield

1) Flue shield shall provide protection from the hot sides of the gas flue hood.

d. Condenser Coil Hail Guard Assembly

1) Shall protect against damage from hail.
2) Shall be of louvered style.

e. Unit-Mounted, Non-Fused Disconnect Switch:

1) Factory-Furnished

f. Convenience Outlet:

1) Convenience outlet to be provided by division 26.

g. Thru-the-Base Connectors:

1) Kits shall provide connectors to permit gas and electrical connections to be brought to the unit through the unit basepan.
2) Minimum of four connection locations per unit.

h. Economizer Relief:

1) Gravity relief.

i. Adapter Roof Curbs (Vertical):

1) Full perimeter adapter type roof curb with exhaust capability providing separate air paths without supply air contamination.
2) Formed galvanized steel with wood nailer strip and shall be capable of supporting entire unit weight.
3) Permits installation and securing of ductwork to curb prior to mounting unit on the curb.
4) Seismically rated hold down clips.

j. High Altitude Gas Conversion Kit:

1) Package shall contain all the necessary hardware and instructions to convert a standard natural gas unit to operate from 2000-7000 ft (610 to 2134m) elevation with natural gas.

k. Smoke Detectors:

1) Devices: Smoke detection devices shall be provided by division 26 and installed in the return air streams on all units supplying greater than 2,000 cfm.

l. Time Guard

1) Shall prevent compressor short cycling by providing a 5-minute delay before restarting a compressor after shutdown for any reason.
2) One device shall be required per compressor.

m. Hinged Access Panels:

1) Shall provide easy access through integrated quarter turn latches.
2) Shall be on major panels – filter, control box, fan motor and compressor

PART 3 - EXECUTION

3.1 INSPECTION:

A. Examine areas and conditions under which air-handling units are to be installed. Do not proceed with work until unsatisfactory conditions have been corrected in manner acceptable to Installer.

3.2 INSTALLATION OF AIR-HANDLING UNITS:

A. General: Install air-handling units where indicated, in accordance with equipment manufacturer's published installation instructions, and with recognized industry practices, to ensure that units comply with requirements and serve intended purposes.

B. Coordination: Coordinate with other work, including ductwork, floor construction, roof decking, piping, and electrical as necessary to interface installation of air-handling units with other work.

C. Access: Provide access space around air handling units for service as indicated, but in no case less than that recommended by manufacturer.

D. Mounting: Mount air conditioning units on a seismic curb with spring vibration isolation, in accordance with manufacturer's instructions.

E. 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-16 sections. Do not proceed with equipment start-up until wiring installation is acceptable to equipment installer.

F. Duct Connections: Refer to Division-23 Air Distribution sections. Provide ductwork, accessories, and flexible connections as indicated.

G. Grounding: Provide positive equipment ground for air-handling unit components.

H. Coil Condensate Drain Trap: Provide coil condensate drain trap of proper size and depth for each side of the rooftop unit coil condensate drain pan.

3.3 FIELD QUALITY CONTROL:

A. Testing: Upon completion of installation of air-handling units, start-up and operate equipment to demonstrate capability and compliance with requirements. Field correct malfunctioning units, then retest to demonstrate compliance.

B. If specified conditions cannot be obtained due to deficiencies in equipment performance or improper installation or workmanship, the Mechanical Contractor and his subcontractors shall make any changes necessary to obtain the specified conditions.

3.4 EXTRA STOCK:

A. Provide one complete extra set of filters for each air handling unit. Install 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. Provide one spare set of belts for each belt-driven air handling unit, obtain receipt from Owner that belts have been received.

END OF SECTION 237410

SECTION 23 76 00 - TERMINAL ELECTRIC HEAT TRANSFER UNITS

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. Division-23 Motors Drives and Electrical Requirements for Mechanical Systems, General Mechanical Requirements, and General Pipes and Fittings sections apply to work of this section.

1.2 SUMMARY:

A. Types of terminal units required for project include the following:

1. Electric Wall Heater
2. Electric Radiant Heater

PART 2 - PRODUCTS

2.1 ELECTRIC WALL HEATERS: (EH)

A. Cabinet constructed of steel with epoxy / polyester powder coat finish. With adjustable louvers.

B. Safeties and Controls:

1. High temperature control with automatic reset.
2. Built-in tamper proof thermostat.
3. Fan delay to purge heater of residual heat.

C. Aluminum-finned, copper clad steel sheath heating element

D. See equipment schedules on drawings for supply voltage.

E. Appropriate mounting brackets for recessed mount.

F. Manufacturer: Subject to compliance with requirements, provide electric wall heaters of one of the following:
1. Reznor
2. Markel Prod. Co.,
3. Raywall,
4. Berko, Marley Electric Co,.
5. QMark, Marley Electric Co,.
6. Brasch Manufacturing Co.
7. Indeeco
8. Heatrex

2.2 ELECTRIC RADIANT HEATERS: (ERH)

A. Welded steel construction with a powder coat finish.

B. Safeties and Controls:

1. High-limit thermostat

C. See equipment schedules on drawings for supply voltage.

D. Appropriate mounting brackets for wall mount.

E. Architect to select color/finish

F. Manufacturer: Subject to compliance with requirements, provide electric wall heaters of one of the following:
1. Runtal
2. Engineer approved equal

PART 3 - EXECUTION

3.1 INSPECTION:

A. Examine areas and conditions under which terminal units are to be installed. Do not proceed with work until unsatisfactory conditions have been corrected in manner acceptable to installer.

3.2 INSTALLATION OF TERMINAL HEAT TRANSFER UNITS:

A. General: Install heaters as indicated, and in accordance with manufacturer's installation instructions.

B. Locate heaters where indicated.

C. Provide and install hangers and supports for heater.

3.3 ELECTRICAL WIRING:

A. General: Install electrical devices furnished by manufacturer but not specified to be factory-mounted.

3.4 ADJUSTING AND CLEANING:

A. General: After construction is completed, including painting, clean unit exposed surfaces, vacuum clean terminal coils and inside of cabinets.

B. Retouch any marred or scratched surfaces of factory-finished cabinets, using finish materials furnished by manufacturer.

END OF SECTION

SECTION 238126 - SPLIT SYSTEM A/C UNIT

PART 1 GENERAL

1.1 SUMMARY

A. Includes But Not Limited To:
   1. Furnish and install split systems as described in Contract Documents.

B. Related Sections:
   1. Division: Concrete pads.
   2. Section 230000: General Mechanical Requirements.

1.2 SUBMITTALS

A. Quality Assurance / Control: Equipment check-out sheets.

1.3 QUALITY ASSURANCE

A. Requirements of Regulatory Agencies: Each unit shall be UL / ULC or ETL labeled.

1.4 WARRANTY

A. Provide five-year warranty on compressors beginning from date of start-up. Record start-up date on warranty certificate for each unit.

PART 2 PRODUCTS

2.1 SPLIT SYSTEM A/C UNIT (SAC-1)

A. Split A/C Units:
   1. Indoor Units:
      a. Wall mounted units as scheduled.
      b. Isolate moving parts from cabinets to reduce noise.
      c. Provide with condensate pump
   2. Outdoor Units:
      a. Compressor serving the multi-split system shall be of swing rocker design, provided with multi-ports to match indoor units served with inverter power modulating control.
      b. Fans shall be direct driven and discharge horizontally.
      c. Casings shall be fully weatherproof for outdoor installations.
      d. Microprocessor Controls shall be factory wired with field installed remote pendant station.

e. Refrigerant shall be R-410a.
f. Factory installed refrigerant circuits shall be provided.
g. Isolate moving parts from cabinets to reduce noise.
h. Use dry-charged tubing for connection of unit's refrigerant system.

3. Accessories:
   a. Provide all indoor units with wired remote controllers installed in secure housings.
4. In addition to that specified above, provide split systems with all standard features to match features of those scheduled.
5. Approved Manufacturers:
   a. Daikin Air Conditioning (Americas) Inc, Carrollton, TX www.daikinac.com.
   b. Carrier Corp, Syracuse, NY www.commercial.carrier.com.
   c. Friedrich Air Conditioning Co, Austin, TX www.friedrich.com.
   d. Mitsubishi Electronics America Inc, HVAC Div, Norcross, GA www.mrslim.com.
   e. Sanyo Air Conditioning Products, Chatsworth, CA www.sanyo.com.
   f. LG

PART 3 EXECUTION

3.1 FIELD QUALITY CONTROL

A. Manufacturer's Field Service: Units shall be started up, checked out, and adjusted by Unit Manufacturer's authorized factory trained service mechanic. Use equipment check-out sheet provided by Manufacturer. Complete and sign all items on sheet.

END OF SECTION

SECTION 26 0500 - GENERAL ELECTRICAL REQUIREMENTS

PART 1 – GENERAL

1.1 SUMMARY

A. Includes But Not Limited To:

1. General electrical system requirements and procedures.
2. Perform excavating and backfilling work required by work of this Division as described in Contract Documents.
3. Make electrical connections to equipment provided under other Sections of these specifications.
4. Furnish and install Penetration Firestop Systems at electrical system penetrations as described in Contract Documents.
5. Furnish and install temperature control system specified in Division 23.

B. Products Supplied But Not Installed Under This Section:

1. Anchor bolts and templates for equipment bases only.

C. Related Sections:

1. Division 02: Criteria for performance of excavating and backfilling.
2. Section 07840: Quality of Penetration Firestop Systems to be used on Project and submittal requirements.
3. Section 259500: Building Automation And Control Commissioning Requirements.

1.2 SUBMITTALS

A. Product Data

1. Provide following information for each item of equipment -
    a. Catalog Sheets.
    b. Assembly details or dimension drawings.
    c. Installation instructions.
    d. Manufacturer's name and catalog number
    e. Name of local supplier.
2. Furnish such information for following equipment -
    a. Wiring devices.
    b. Disconnects.
    c. Transformers.
    d. Panelboards.
    e. Motor starters.

f. Motor control centers.

g. Conductors and cables.

h. Lighting fixtures, poles, and associated control equipment.

i. Medium voltage equipment.

j. Conductors and cables.

3. Do not purchase equipment before approval of product data.

B. Shop Drawings

1. Submit on following equipment -

a. Panelboards

b. Medium Voltage Switchgear

c. Medium voltage vaults, conduits, and cable.

d. Low Voltage Relay Lighting Panel

e. Seismic Supports and Restraints

f. Transformers

2. Indicate precise equipment to be used, including all options specified, installation instructions dimensions, support method, etc. Indicate wording and format of nameplates where applicable. Submit in three-ring binder with hard cover.

C. Quality Assurance / Control:

1. Report of site tests, before Substantial Completion.

D. Closeout

1. Operations And Maintenance Manual Data -

a. Modify and add to requirements of General Requirements as follows -

1) Provide operating and maintenance instructions for each item of equipment submitted under Product Data.

2) Include copy of approved shop drawings.

1.3 QUALITY ASSURANCE

A. Requirements of Regulatory Agencies

1. National Electrical Code (NEC) and local ordinances and regulations shall govern unless more stringent requirements are specified.

2. Material and equipment provided shall meet standards of NEMA or UL, or ULC, CSA, or EEMAC and bear their label wherever standards have been established and label service is available.

B. Pre-installation Meeting

1. Prior to commencement of work specified in Division 26 and appropriate Division 23

Sections conduct pre-installation meetings with Project Manager, Contractor, Electrical Contractor and his sub-trades, and item or system suppliers / installers.

2. Review progress of other construction activities and preparations for particular activity including, but not limited to- requirements for coordination between sections, Deliveries, Compatibility of materials, space and access limitations, Governing regulations, testing requirements, protection, and pre-commissioning of building systems

1.4 OWNER'S INSTRUCTIONS

A. Provide competent instructor for three days to train maintenance personnel in operation and maintenance of electrical equipment and systems. Factory representatives shall assist this instruction as necessary. Schedule instruction period at time of final inspection.

PART 2 - PRODUCTS - Not Used

PART 3 – EXECUTION

3.1 EXAMINATION

A. Confirm dimensions, ratings, and specifications of equipment to be installed and coordinate these with site dimensions and with other Sections.

3.2 INSTALLATION

A. General

1. Locations of electrical equipment shown on Drawings are approximate only. Field verify actual locations for proper installation.

2. Coordinate electrical equipment locations and conduit runs with those providing equipment to be served prior to installation or rough-in.

   a. Notify Engineer of conflicts before beginning work.

   b. Coordinate locations of power and lighting outlets in mechanical rooms and other areas with mechanical equipment, piping, ductwork, cabinets, etc, so they will be readily accessible and functional.

3. Work related to other trades which is required under this Division, such as cutting and patching, trenching, and backfilling, shall be performed according to standards specified in applicable Sections.

B. Mounting Heights

1. Unless otherwise indicated, mount center of outlets or boxes at following heights above finish floor. Field coordinate with Architectural drawings, Architect and field conditions for exact placement.

   a. Temperature Control Junction Boxes - As indicated on Drawings

   b. Thermostats - As indicated on Drawings

   c. Remote Temperature Sensors - 56 inches to top

   d. Condensing Unit Disconnects - Top same height as top of unit

   e. Other Motor Disconnects - 60 inches

f. Distribution Panels - 72 inches to top

g. Receptacles - 18 inches

h. Switches - 42 inches

i. Wall-Mounted Exit Lights - 90 inches

k. Sound / Satellite / TV Distribution System Components: As indicated on Drawings.

l. Computer and TV: 18 inches or at 7'-0" for wall mounted T.V.'s.

m. Electric Water Cooler Outlets: Mount so outlet and cord are hidden by water cooler.

n. Motor controls: 60 inches.

o. Telephone / Data Terminal Boards: 72 inches.

p. Telephones (wall type): 48 inches 1 200 mm [60 inches on D I Stores].

q. Telephones (desk type): 18 inches.

r. Telephone / Data (desk type): 18 inches.

s. TV Outlets: 18 inches or at 7'-0" for wall mounted T.V.'s.

t. Clock Displays (Session Status): 66 inches.

u. Endowment Room Panels: 60 inches.

v. Signal Chimes: 84 inches.

2. Refer special conditions to Engineer before rough-in and locate outlet under his direction.

3.3 FIELD QUALITY CONTROL

A. Site Tests - Test systems and demonstrate equipment as working and operating properly. Notify Engineer prior to test. Rectify defects at no additional cost to Owner.

B. Measure current for each phase of each motor under actual final load operation, i.e. after air balance is completed for fan units, etc. Record this information along with full-load nameplates current rating and size of thermal overload unit installed for each motor.

END OF SECTION 260500

SECTION 26 0510 - OPERATION AND MAINTENANCE MANUALS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division-01 Specifications sections, apply to work of this section.

B. Division-26 General Electrical Requirements sections apply to work of this section.

1.2 SUMMARY

A. Furnish four sets of bound operation and maintenance manuals. Manuals shall contain descriptive drawings and data which identify equipment installed at the project and detail the procedures and parts required to maintain and repair the equipment. Copies of approved submittals shall be included for all equipment.

1.3 OPERATION AND MAINTENANCE MANUAL FOR ELECTRICAL AND INSTRUMENTATION SYSTEMS

A. General:

1. The "Operating and Maintenance Manual" (Electrical and Instrumentation) is a bound compilation of drawings and data that the owner requires for each building or project. These manuals, complete with drawings and data, shall be furnished to the Owner.

2. The electrical CONTRACTOR has overall responsibility to obtain the necessary data and compile the data as set forth in this specification, including items or equipment purchased by the Owner and delivered to the CONTRACTOR for installation.

3. The number of binders (or "volumes") required will depend on the amount of information to be catalogued. Total "sets" see paragraph 1.2 A.

4. Make all information legible and sufficiently marked to indicate the exact size, model, type, etc., of equipment furnished and installed.

B. Purpose: The Operating and Maintenance Manual is prepared to provide a ready reference to all important pieces of mechanical and electrical equipment installed on the project. It is also to provide the necessary operating and maintenance data for use by service personnel. It is also to provide information required for checking equipment performance or for planning of plant expansion or redesign.

PART 2 - PRODUCTS

2.1 PAGE SIZE:

A. All pages shall be standard 8-1/2 x 11 inches size or approximate multiples (preferably 16 x 11 inches) folded to 8-1/2 x 11 inch.

2.2 DRAWINGS:

A. All drawings larger than 8-1/2" x 11" shall be folded and inserted in individual 8-1/2" x

1. 11" manila pockets, which shall have standard three-ring side punching for insertion in the binders. The equipment name, drawing description and number shall be written on the face of each manila pocket.

2.3 BINDERS:

A. Binders shall be Buckram (stiffened fabric), bar-lock type binders with block lettering for sheet size 8-1/2 x 11 inches with 2" to 3-1/2" expandable metal capacity as required for the project. The number of binders, however, shall be based on not filling them beyond 4".

B. Place the following information on the front cover and backbone:

1. "Operation and Maintenance Manual".
2. Project Name (and volume number if more than one volume).
    a. Project Number
3. Building name and number.
4. Architect's name.
5. ENGINEER's name.
6. General CONTRACTOR's name.
7. Electrical CONTRACTOR's name.
8. Items 5 through 7 need not be printed on the backbone.

2.4 CONTENTS AND INDEXING

A. Manuals shall contain descriptions of the building systems in sufficient detail to adequately indicate the type of systems installed and the basic details of their operation.

B. All purchased equipment data shall be used to designate the sections. Within each section additional indexing of component parts may be required.

C. Operation and Maintenance Manuals shall contain to the fullest extent all possible information pertinent to the equipment. The arrangement and type of information to be filed shall be as follows:

1. Copy of purchase order change (if any).
2. Outline drawings, special construction details, as built electrical wiring and control diagrams for all major and supplementary systems.
3. Manufacturer’s test or calculated performance data and certified test curves.
4. Installation, operating, and maintenance instructions, including a complete parts list and sectional drawing with parts identification numbers. Mark with model, size and plan number.
5. Manufacturer’s brochure marked to indicate exact equipment purchased. Brochures on component parts supplied by a manufacturer with his equipment, but not manufactured directly by him, shall also be included.
6. The serial numbers of each item of equipment installed are to be listed with the

model numbers and plan symbols.

7. Include a Table of Contents. The contents shall be divided with tabbed index dividers into the following suggested parts:

Part I	Building and System Descriptions
Part II	Purchased Equipment Data
Part III	Test Reports and Charts
Part IV	Start-Up and Operation
Part V	Preventative Maintenance Recommendations
Part VI	Software/Programming Data/Program CD's

8. A copy of the approved submittals for each piece of equipment.
9. A copy of all testing reports.
10. Wiring diagrams, marked with model and size and plan symbol.
11. The index shall contain the name and address of the manufacturer and, if different, where replacement and repair parts may be obtained.
12. Copies of developed software, programmed set points, screens, etc. on C.D.

END OF SECTION 260510

SECTION 260519 - LOW-VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Copper building wire rated 600 V or less.
2. Metal-clad cable, Type MC, rated 600 V or less.
3. Armored cable, Type AC, rated 600 V or less.
4. Photovoltaic cable, Type PV, rated 2000 V or less.
5. Mineral-insulated cable, Type MI, rated 600 V or less.
6. Tray cable, Type TC, rated 600 V or less.
7. Fire-alarm wire and cable.
8. Connectors, splices, and terminations rated 600 V and less.

B. Related Requirements:

1. Section 271500 "Communications Horizontal Cabling" for twisted pair cabling used for data circuits.

1.3 DEFINITIONS

A. PV: Photovoltaic.

B. RoHS: Restriction of Hazardous Substances.

C. VFC: Variable-frequency controller.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Product Schedule: Indicate type, use, location, and termination locations.

1.5 INFORMATIONAL SUBMITTALS

A. Qualification Data: For testing agency.

B. Field quality-control reports.

1.6 QUALITY ASSURANCE

A. Testing Agency Qualifications: Member company of NETA.

1. Testing Agency's Field Supervisor: Certified by NETA to supervise on-site testing.

PART 2 - PRODUCTS

2.1 COPPER BUILDING WIRE

A. Description: Flexible, insulated and uninsulated, stranded copper current-carrying conductor with an overall insulation layer or jacket, or both, rated 600 V or less.

B. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Belden Inc.

2. Cerro Wire LLC.

3. Encore Wire Corporation.

4. General Cable Technologies Corporation.

5. Okonite Company (The).

6. Service Wire Co.

7. Southwire Company.

8. WESCO.

C. Standards:

1. Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and use.

2. RoHS compliant.

3. Conductor and Cable Marking: Comply with wire and cable marking according to UL's "Wire and Cable Marking and Application Guide."

D. Conductors: Copper, stranded, complying with ASTM B3 for bare annealed copper and with ASTM B8 for stranded conductors.

E. Conductor Insulation:

1. Type NM: Comply with UL 83 and UL 719.

2. Type TC-ER: Comply with NEMA WC 70/ICEA S-95-658 and UL 1277.

3. Type THWN-2: Comply with UL 83 for interior wiring.

4. Type XHHW-2: Comply with UL 44 for all exterior or underground wiring.

F. Shield:

1. Type TC-ER: Cable designed for use with VFDs, with oversized crosslinked polyethylene insulation, spiral-wrapped foil plus 85 percent coverage braided shields and insulated full-size ground wire, and sunlight- and oil-resistant outer PVC jacket.

2.2 METAL-CLAD CABLE, TYPE MC

A. Description: A factory assembly of one or more current-carrying insulated conductors in an overall metallic sheath.

B. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. General Cable Technologies Corporation.

2. Okonite Company (The).

3. Southwire Company.

C. Standards:

1. Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and use.

2. Comply with UL 1569.

3. RoHS compliant.

4. Conductor and Cable Marking: Comply with wire and cable marking according to UL's "Wire and Cable Marking and Application Guide."

D. Circuits:

1. Single circuit and multi-circuit with color-coded conductors.

2. Power-Limited Fire-Alarm Circuits: Comply with UL 1424.

E. Conductors: Stranded Copper, complying with ASTM B8 for stranded conductors.

F. Ground Conductor: Insulated.

G. Conductor Insulation:

1. Type XHHW-2: Comply with UL 44.

H. Armor: Steel, interlocked.

I. Jacket: PVC applied over armor.

2.3 TRAY CABLE, TYPE TC

A. Description: A factory assembly of insulated current-carrying conductors with or without an equipment grounding conductor in a nonmetallic jacket.

B. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Belden Inc.

2. Encore Wire Corporation.

3. General Cable Technologies Corporation.

4. Okonite Company (The).

5. Southwire Company.

6. WESCO.

C. Standards:

1. Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and use.

2. RoHS compliant.

3. Comply with UL 1277.

4. Comply with ICEA S-73-532/NEMA WC 57 for Type TC cables used for control, thermocouple extension, and instrumentation.

5. Comply with ICEA S-95-658/NEMA WC 70 for Type TC cables used for power distribution.

6. Conductor and Cable Marking: Comply with wire and cable marking according to UL's "Wire and Cable Marking and Application Guide."

D. Conductors: Stranded Copper, complying and with ASTM B8 for stranded conductors.

E. Ground Conductor: Insulated.

F. Conductor Insulation: Type XHHW-2. Comply with UL 44.

G. Shield: None.

2.4 FIRE-ALARM WIRE AND CABLE

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Allied Wire & Cable Inc.

2. CommScope, Inc.

3. Comtran Corporation.

4. Draka Cableteq USA; a Prysmian Group company.

5. Genesis Cable Products; Honeywell International, Inc.

6. Radix Wire.

7. Rockbestos-Suprenant Cable Corp.

8. Superior Essex Inc.

9. West Penn Wire.

B. General Wire and Cable Requirements: NRTL listed and labeled as complying with NFPA 70, Article 760.

C. Signaling Line Circuits: Twisted, shielded pair, not less than No. 18 AWG size as recommended by system manufacturer.

1. Circuit Integrity Cable: Twisted shielded pair, NFPA 70, Article 760, Classification CI, for power-limited fire-alarm signal service Type FPL. NRTL listed and labeled as complying with UL 1424 and UL 2196 for a two-hour rating.

D. Non-Power-Limited Circuits: Stranded-copper conductors with 600-V rated, 75 deg C, color-coded insulation, and complying with requirements in UL 2196 for a two-hour rating.

1. Low-Voltage Circuits: No. 16 AWG, minimum, in pathway.

2. Line-Voltage Circuits: No. 12 AWG, minimum, in pathway.

3. Multiconductor Armored Cable: NFPA 70, Type MC, copper conductors, Type TFN/THHN conductor insulation, copper drain wire, copper armor with outer jacket with red identifier stripe, NTRL listed for fire-alarm and cable tray installation, plenum rated.

2.5 CONNECTORS AND SPLICES

A. Description: Factory-fabricated connectors, splices, and lugs of size, ampacity rating, material, type, and class for application and service indicated; listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and use.

B. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. 3M Electrical Products.

2. AFC Cable Systems; a part of Atkore International.

3. Hubbell Power Systems, Inc.

4. Ideal Industries, Inc.

5. ILSCO.

6. O-Z/Gedney; a brand of Emerson Industrial Automation.

7. Service Wire Co.

8. Thomas & Betts Corporation; A Member of the ABB Group.

C. Jacketed Cable Connectors: For steel and aluminum jacketed cables, zinc die-cast with set screws, designed to connect conductors specified in this Section.

D. Lugs: One piece, seamless, designed to terminate conductors specified in this Section.

1. Material: Copper Bronze.

2. Type: Two hole with long barrels.

3. Termination: Crimp.

PART 3 - EXECUTION

3.1 CONDUCTOR MATERIAL APPLICATIONS

A. Feeders: Copper; Stranded.

B. Feeders: Copper. Conductors shall be stranded.

C. Branch Circuits: Copper. Stranded.

D. Branch Circuits: Copper. Stranded.

E. VFC Output Circuits Cable: Extra-flexible stranded for all sizes.

F. Power-Limited Fire Alarm and Control: Stranded.

3.2 CONDUCTOR INSULATION AND MULTICONDUCTOR CABLE APPLICATIONS AND WIRING METHODS

A. Exposed Feeders: Type THHN/THWN-2, single conductors in raceway Type XHHW-2, single conductors in raceway, only as approved by Engineer.

B. Feeders Concealed in Ceilings, Walls, Partitions, and Crawlspaces: Type THHN/THWN-2, single conductors in raceway only as approved by Engineer.

C. Feeders Concealed in Concrete, below Slabs-on-Grade, and Underground: Type XHHW-2, single conductors in raceway.

D. Feeders Installed below Raised Flooring: Type THHN/THWN-2, single conductors in raceway Metal-clad cable, Type MC.

E. Feeders in Cable Tray: Type XHHW-2, single conductors larger than No. 1/0 AWG Metal-clad cable, Type MC.

F. Exposed Branch Circuits, Including in Crawlspaces, or accessible ceilings: Type THHN/THWN-2, single conductors in raceway or Metal-clad cable, Type MC.

G. Branch Circuits Concealed in Ceilings, Walls, and Partitions: Type THHN/THWN-2, single conductors in raceway only as approved by Engineer.

H. Branch Circuits Concealed in Concrete, below Slabs-on-Grade, and Underground: Type THHN/THWN-2, single conductors in raceway Type XHHW-2, single conductors in raceway.

I. Branch Circuits Installed below Raised Flooring: Type THHN/THWN-2, single conductors in raceway Metal-clad cable, Type MC only as approved by Engineer.

J. Branch Circuits in Cable Tray: Type XHHW-2, single conductors larger than No. 1/0 AWG Metal-clad cable, Type MC.

K. Cord Drops and Portable Appliance Connections: Type SO, hard service cord with stainless-steel, wire-mesh, strain relief device at terminations to suit application.

L. VFD Output Circuits: Type XHHW-2 in metal conduit Type TC-ER cable with braided shield.

3.3 INSTALLATION OF CONDUCTORS AND CABLES

A. Conceal cables in finished walls, ceilings, and floors unless otherwise indicated.

B. Complete raceway installation between conductor and cable termination points according to Section 260533 "Raceways and Boxes for Electrical Systems" prior to pulling conductors and cables.

C. Use manufacturer-approved pulling compound or lubricant where necessary; compound used must not deteriorate conductor or insulation. Do not exceed manufacturer's recommended maximum pulling tensions and sidewall pressure values.

D. Use pulling means, including fish tape, cable, rope, and basket-weave wire/cable grips, that will not damage cables or raceway.

E. Install exposed cables parallel and perpendicular to surfaces of exposed structural members, and follow surface contours where possible. Cables must be installed in a neat and orderly fashion in parallel one with another. Cables shall be labeled as to the circuit of the panelboard at all termination point.

F. Support cables according to Section 260529 "Hangers and Supports for Electrical Systems."

G. Complete cable tray systems installation according to Section 260536 "Cable Trays for Electrical Systems" prior to installing conductors and cables.

3.4 INSTALLATION OF FIRE-ALARM WIRING

A. Comply with NECA 1 and NFPA 72.

B. Wiring Method: Install wiring in metal pathway according to Section 270528.29 "Hangers and Supports for Communications Systems."

1. Install plenum cable in environmental airspaces, including plenum ceilings.

2. Fire-alarm circuits and equipment control wiring associated with fire-alarm system shall be installed in a dedicated pathway system. This system shall not be used for any other wire or cable.

C. Wiring Method:

1. Cables and pathways used for fire-alarm circuits, and equipment control wiring associated with fire-alarm system, may not contain any other wire or cable.

2. Fire-Rated Cables: Use of two-hour, fire-rated fire-alarm cables, NFPA 70, Types MI and CI, is not permitted.

3. Signaling Line Circuits: Power-limited fire-alarm cables shall not be installed in the same cable or pathway as signaling line circuits.

D. Wiring within Enclosures: Separate power-limited and non-power-limited conductors as recommended by manufacturer. Install conductors parallel with or at right angles to sides and back of the enclosure. Bundle, lace, and train conductors to terminal points with no excess. Connect conductors that are terminated, spliced, or interrupted in any enclosure associated with fire-alarm system to terminal blocks. Mark each terminal according to system's wiring diagrams. Make all connections with approved crimp-on terminal spade lugs, pressure-type terminal blocks, or plug connectors.

E. Cable Taps: Use numbered terminal strips in junction, pull, and outlet boxes; cabinets; or equipment enclosures where circuit connections are made.

F. Color-Coding: Color-code fire-alarm conductors differently from the normal building power wiring. Use one color-code for alarm circuit wiring and another for supervisory circuits. Color-code audible alarm-indicating circuits differently from alarm-initiating circuits. Use different colors for visible alarm-indicating devices. Paint fire-alarm system junction boxes and covers red.

G. Risers: Install at least two vertical cable risers to serve the fire-alarm system. Separate risers in close proximity to each other with a minimum one-hour-rated wall, so the loss of one riser does not prevent receipt or transmission of signals from other floors or zones.

H. Wiring to Remote Alarm Transmitting Device: 1-inch (25-mm) conduit between the fire-alarm control panel and the transmitter. Install number of conductors and electrical supervision for connecting wiring as needed to suit monitoring function.

3.5 CONNECTIONS

A. Tighten electrical connectors and terminals according to manufacturer's published torque-tightening values. If manufacturer's torque values are not indicated, use those specified in UL 486A-486B.

B. Make splices, terminations, and taps that are compatible with conductor material and that possess equivalent or better mechanical strength and insulation ratings than un-spliced conductors.

C. Wiring at Outlets: Install conductor at each outlet, with at least 12 inches (300 mm) of slack.

D. Comply with requirements in Section 283111 "Digital, Addressable Fire-Alarm System" Section 283112 "Zoned (DC Loop) Fire-Alarm System" for connecting, terminating, and identifying wires and cables.

3.6 IDENTIFICATION

A. Identify and color-code conductors and cables according to Section 260553 "Identification for Electrical Systems."

B. Identify each spare conductor at each end with identity number and location of other end of conductor, and identify as spare conductor.

3.7 SLEEVE AND SLEEVE-SEAL INSTALLATION FOR ELECTRICAL PENETRATIONS

A. Install sleeves and sleeve seals at penetrations of exterior floor and wall assemblies. Comply with requirements in Section 260544 "Sleeves and Sleeve Seals for Electrical Raceways and Cabling."

3.8 FIRESTOPPING

A. Apply firestopping to electrical penetrations of fire-rated floor and wall assemblies to restore original fire-resistance rating of assembly according to Section 078413 "Penetration Firestopping."

3.9 FIELD QUALITY CONTROL

A. Testing Agency: Owner will engage a qualified testing agency to perform tests and inspections.

B. Testing Agency: Engage a qualified testing agency to perform tests and inspections.

C. Manufacturer's Field Service: Engage a factory-authorized service representative to test and inspect components, assemblies, and equipment installations, including connections.

D. Perform tests and inspections.

1. After installing conductors and cables and before electrical circuitry has been energized, test service entrance and feeder conductors for compliance with requirements.

2. After installing conductors and cables and before electrical circuitry has been energized, test service entrance and feeder conductors and conductors.

E. CABLE TESTING PROCEDURES

1. Cables shall be megger tested. Each cable shall be megger tested on an individual basis.

2. Grouping of phase conductors for a group measurement shall not be permitted.

3. Each conductor shall have its insulation resistance tested after the installation is completed and all splices, taps, and connections are made except connection to or into its source and point (or points) of termination.

4. Insulation resistance of conductors which are to operate at 600 volts or less shall be tested by using Biddle (or approved equal) Megger with an output of not less than 1000 volts d.c. Conductors shall be tested between phase conductors, between each phase conductor

and neutral and ground, and between neutral and ground. Reading shall be observed after 15 seconds of operation of the Megger. Insulation resistance of conductors rated at 0-250 volts shall be tested at 500 volts and shall be not less than fifty (50) mega-ohms (50,000,000 ohms), 251-600 volt conductors shall be tested at 1000 volts and shall be not less than one hundred (100) mega ohms (100,000,000 ohms), or the latest NEMA (IPCEA) Standard requirement for the conductor type or governing Code, whichever is more stringent.

5. Conductors that do not exceed insulation resistance values listed above shall be removed and replaced and test repeated. The Contractor shall furnish all instruments and personnel required for tests.

6. Contractor shall tabulate readings observed and shall forward four copies of test readings to the Engineer for review. These test reports shall identify each conductor tested, date and time of test, test equipment utilized (make, model and serial number) and its latest date of certification. Each test shall be signed by party making the test. Any conductor, splice or end device which is found defective shall be promptly removed and replaced, and additional tests shall be performed.

7. The above testing and report requirements shall apply to all No.14 and larger conductors. Conductors control circuits and signal circuits shall be checked in accordance with the California Electrical Code. If values are less than the minimum values noted above in paragraph 4, the feeder conductors, splices and/or devices shall be removed and replaced with conductors of identical size and retested.

8. If all tests are acceptable, the contractor shall terminate conductors to circuit breaker, neutral bar and ground bar and energize the circuit in the manner noted in the able below.

9. Field Voltage Testing:

    a. Check each end device (every receptacle) with a voltmeter. Following are acceptable results:

        1) Approximately 120 Volts between Phase and neutral

        2) Approximately 120 Volts between Phase and neutral

10. Results shall be tabulated in a table similar to below:

PANEL DESIGNATION: UL4A	LOCATION: West Closet A

CIRCUIT	LOAD	CKT. CONF.	OUTLET TEST	WIRE SIZE	AMPS	MEGOHMS
1						
2						
3						
4						
5						
6						
7						
8						
9						
10						
11						
12						
13						
14						
15						
16						
17						
18						
19						
20						
21						
22						
23						

24						
25						

11. Initial Infrared Scanning: After Substantial Completion, but before 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. Instrument: Use an infrared scanning device designed to measure temperature or to detect significant deviations from normal values. Provide calibration record for device.

    b. Record of Infrared Scanning: Prepare a certified report that identifies switches checked and that describes scanning results. Include notation of deficiencies detected, remedial action taken, and observations after remedial action.

12. Follow-up Infrared Scanning: Perform an additional follow-up infrared scan of each switch 11 months after date of Substantial Completion.

F. Cables will be considered defective if they do not pass tests and inspections.

G. Prepare test and inspection reports to record the following:

1. Procedures used.

2. Results that comply with requirements.

3. Results that do not comply with requirements, and corrective action taken to achieve compliance with requirements.

END OF SECTION 26 0519

SECTION 260526 - GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section includes grounding and bonding systems and equipment.

B. Section includes grounding and bonding systems and equipment, plus the following special applications:

1. Underground distribution grounding.

2. Ground bonding common with lightning protection system.

3. Foundation steel electrodes.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product indicated.

1.3 INFORMATIONAL SUBMITTALS

A. Coordination Drawings: Plans showing dimensioned locations of grounding features specified in "Field Quality Control" Article, including the following:

1. Test wells.

2. Ground rods.

3. Ground rings.

4. Grounding arrangements and connections for separately derived systems.

A. Qualification Data: For testing agency and testing agency's field supervisor.

A. Field quality-control reports.

1.2 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) Plans showing as-built, dimensioned locations of system described in "Field Quality Control" Article, including the following:

1) Test wells.

2) Ground rods.

3) Ground rings.

4) Grounding arrangements and connections for separately derived systems.

a) Instructions for periodic testing and inspection of grounding features at test wells, ground rings, grounding connections for separately derived systems based on NETA MTS NFPA 70B.

1) Tests shall determine if ground-resistance or impedance values remain within specified maximums, and instructions shall recommend corrective action if values do not.

2) Include recommended testing intervals.

1.2 QUALITY ASSURANCE

A. Testing Agency Qualifications: Certified by NETA.

PART 2 - PRODUCTS

2.1 SYSTEM DESCRIPTION

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

B. Comply with UL 467 for grounding and bonding materials and equipment.

2.2 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. ERICO; a brand of nVent.

2. Hubbell Incorporated (Construction and Energy Group).

3. ILSCO.

4. O-Z/Gedney; a brand of Emerson Industrial Automation.

5. Thomas & Betts Corporation; A Member of the ABB Group.

2.3 CONDUCTORS

A. Insulated Conductors: tinned-copper wire or cable insulated for 600 V unless otherwise required by applicable Code or authorities having jurisdiction.

B. Bare Copper Conductors:

1. Solid Conductors: ASTM B3.

2. Stranded Conductors: ASTM B8.

3. Tinned Conductors: ASTM B33.

4. Bonding Cable: 28 kcmil, 14 strands of No. 17 AWG conductor, 1/4 inch (6 mm) in diameter.

5. Bonding Conductor: No. 4 or No. 6 AWG, stranded conductor.

6. Bonding Jumper: Copper tape, braided conductors terminated with copper ferrules; 1-5/8 inches (41 mm) wide and 1/16 inch (1.6 mm) thick.

7. Tinned Bonding Jumper: Tinned-copper tape, braided conductors terminated with copper ferrules; 1-5/8 inches (41 mm) wide and 1/16 inch (1.6 mm) thick.

C. Grounding Bus: Predrilled rectangular bars of annealed copper, 1/4 by 4 inches (6.3 by 100 mm) 12" Long or as needed, in cross section, with 9/32-inch (7.14-mm) holes spaced 1-1/8 inches (28 mm) apart. Stand-off insulators for mounting shall comply with UL 891 for use in switchboards, 600 V and shall be Lexan or PVC, impulse tested at 5000 V.

2.4 CONNECTORS

A. Listed and labeled by an NRTL acceptable to authorities having jurisdiction for applications in which used and for specific types, sizes, and combinations of conductors and other items connected.

B. Welded Connectors: Exothermic-welding kits of types recommended by kit manufacturer for materials being joined and installation conditions.

C. Bus-Bar Connectors: Mechanical type, cast silicon bronze, solderless compression-type wire terminals, and long-barrel, two-bolt connection to ground bus bar.

D. Bus-Bar Connectors: Compression type, copper or copper alloy, with two wire terminals.

E. Beam Clamps: Mechanical type, terminal, ground wire access from four directions, with dual, tin-plated or silicon bronze bolts.

F. Cable-to-Cable Connectors: Compression type, copper or copper alloy.

G. Cable Tray Ground Clamp: Mechanical type, zinc-plated malleable iron.

H. Conduit Hubs: Mechanical type, terminal with threaded hub.

I. Ground Rod Clamps: Mechanical type, copper or copper alloy, terminal with hex head bolt.

J. Lay-in Lug Connector: Mechanical type, copper rated for direct burial terminal with set screw.

K. Service Post Connectors: Mechanical type, bronze alloy terminal, in short- and long-stud lengths, capable of single and double conductor connections.

L. Signal Reference Grid Clamp: Mechanical type, stamped-steel terminal with hex head screw.

M. Straps: Solid copper, copper lugs. Rated for 600 A.

N. Tower Ground Clamps: Mechanical type, copper or copper alloy, terminal one-piece clamp.

O. U-Bolt Clamps: Mechanical type, copper or copper alloy, terminal listed for direct burial.

P. Water Pipe Clamps:

1. Mechanical type, two pieces with stainless-steel bolts.

a. Material: Die-cast zinc alloy.

b. Listed for direct burial.

2. U-bolt type with malleable-iron clamp and copper ground connector rated for direct burial.

2.5 GROUNDING ELECTRODES

A. Ground Rods: Copper-clad steel; 3/4 inch by 10 feet (19 mm by 3 m).

B. Chemical-Enhanced Grounding Electrodes: Copper tube, straight or L-shaped, charged with nonhazardous electrolytic chemical salts.

1. Termination: Factory-attached No. 4/0 AWG bare conductor at least 48 inches (1200 mm) long.

2. Backfill Material: Electrode manufacturer's recommended material.

C. Ground Plates: 1/4 inch (6 mm) thick, hot-dip galvanized.

PART 3 - EXECUTION

3.1 APPLICATIONS

A. Conductors: Install solid conductor for No. 8 AWG and smaller, and stranded conductors for No. 6 AWG and larger unless otherwise indicated.

B. Underground Grounding Conductors: Install bare tinned-copper conductor, 250kcmil minimum.

1. Bury at least 30 inches (750 mm) below grade.

2. Duct-Bank Grounding Conductor: Bury 12 inches (300 mm) above duct bank when indicated as part of duct-bank installation.

C. Grounding Conductors: Green-colored insulation with continuous yellow stripe.

D. Isolated Grounding Conductors: Green-colored insulation with more than one continuous yellow stripe. On feeders with isolated ground, identify grounding conductor where visible to normal inspection, with alternating bands of green and yellow tape, with at least three bands of green and two bands of yellow.

E. Grounding Bus: Install in electrical equipment rooms, in rooms housing service equipment, and elsewhere as indicated.

1. Install bus horizontally, on insulated spacers 2 inches (50 mm) minimum from wall, 6 inches (150 mm) above finished floor unless otherwise indicated.

2. Where indicated on both sides of doorways, route bus up to top of door frame, across top of doorway, and down; connect to horizontal bus.

F. Conductor Terminations and Connections:

1. Pipe and Equipment Grounding Conductor Terminations: Bolted connectors.

2. Underground Connections: Welded connectors except at test wells and as otherwise indicated.

3. Connections to Ground Rods at Test Wells: Bolted connectors.

4. Connections to Structural Steel: Welded connectors.

3.2 GROUNDING AT THE SERVICE

A. Equipment grounding conductors and grounding electrode conductors shall be connected to the ground bus. Install a main bonding jumper between the neutral and ground buses.

3.3 GROUNDING SEPARATELY DERIVED SYSTEMS

A. Generator: Install grounding electrode(s) at the generator location. The electrode shall be connected to the equipment grounding conductor and to the frame of the generator.

3.4 GROUNDING UNDERGROUND DISTRIBUTION SYSTEM COMPONENTS

A. Comply with IEEE C2 grounding requirements.

B. Grounding Manholes and Handholes: Install a driven ground rod through manhole or handhole floor, close to wall, and set rod depth so 4 inches (100 mm) will extend above finished floor. If necessary, install ground rod before manhole is placed and provide No. 1/0 AWG bare, tinned-copper conductor from ground rod into manhole through a waterproof sleeve in manhole wall. Protect ground rods passing through concrete floor with a double wrapping of pressure-sensitive insulating tape or heat-shrunk insulating sleeve from 2 inches (50 mm) above to 6 inches (150 mm) below concrete. Seal floor opening with waterproof, non-shrink grout.

C. Grounding Connections to Manhole Components: Bond exposed-metal parts such as inserts, cable racks, pulling irons, ladders, and cable shields within each manhole or handhole, to ground rod or grounding conductor. Make connections with No. 4 AWG minimum, stranded, hard-drawn copper bonding conductor. Train conductors level or plumb around corners and fasten to manhole walls. Connect to cable armor and cable shields according to written instructions by manufacturer of splicing and termination kits.

D. Pad-Mounted Transformers and Switches: Install two ground rods and ground ring around the pad. Ground pad-mounted equipment and noncurrent-carrying metal items associated with substations by connecting them to underground cable and grounding electrodes. Install tinned-copper conductor not less than No. 2 AWG for ground ring and for taps to equipment grounding terminals. Bury ground ring not less than 6 inches (150 mm) from the foundation.

3.5 EQUIPMENT GROUNDING

A. Install insulated equipment grounding conductors with all feeders and branch circuits.

B. Install insulated equipment grounding conductors with the following items, in addition to those required by NFPA 70:

1. Feeders and branch circuits.

2. Lighting circuits.

3. Receptacle circuits.

4. Single-phase motor and appliance branch circuits.

5. Three-phase motor and appliance branch circuits.

6. Flexible raceway runs.

7. Armored and metal-clad cable runs.

8. Busway Supply Circuits: Install insulated equipment grounding conductor from grounding bus in the switchgear, switchboard, or distribution panel to equipment grounding bar terminal on busway.

9. X-Ray Equipment Circuits: Install insulated equipment grounding conductor in circuits supplying x-ray equipment.

C. Air-Duct Equipment Circuits: Install insulated equipment grounding conductor to duct-mounted electrical devices operating at 120 V and more, including air cleaners, heaters, dampers, humidifiers, and other duct electrical equipment. Bond conductor to each unit and to air duct and connected metallic piping.

D. Water Heater, Heat-Tracing, and Antifrost Heating Cables: Install a separate insulated equipment grounding conductor to each electric water heater and heat-tracing cable. Bond conductor to heater units, piping, connected equipment, and components.

E. Isolated Grounding Receptacle Circuits: Install an insulated equipment grounding conductor connected to the receptacle grounding terminal. Isolate conductor from raceway and from panelboard grounding terminals. Terminate at equipment grounding conductor terminal of the applicable derived system or service unless otherwise indicated.

F. Isolated Equipment Enclosure Circuits: For designated equipment supplied by a branch circuit or feeder, isolate equipment enclosure from supply circuit raceway with a nonmetallic raceway fitting listed for the purpose. Install fitting where raceway enters enclosure, and install a separate insulated equipment grounding conductor. Isolate conductor from raceway and from panelboard grounding terminals. Terminate at equipment grounding conductor terminal of the applicable derived system or service unless otherwise indicated.

G. Poles Supporting Outdoor Lighting Fixtures: Install grounding electrode and a separate insulated equipment grounding conductor in addition to grounding conductor installed with branch-circuit conductors.

H. Metallic Fences: Comply with requirements of IEEE C2.

1. Grounding Conductor: Bare copper, not less than No. 8 AWG.

2. Gates: Shall be bonded to the grounding conductor with a flexible bonding jumper.

3. Barbed Wire: Strands shall be bonded to the grounding conductor.

3.6 FENCE GROUNDING

A. Fence Grounding: Install at maximum intervals of 500 feet (150 m) except as follows:

1. Fences within 100 Feet (30 m) of Buildings, Structures, Walkways, and Roadways: Ground at maximum intervals of 250 feet (75 m).

a. Gates and Other Fence Openings: Ground fence on each side of opening.

1) Bond metal gates to gate posts.

2) Bond across openings, with and without gates, except at openings indicated as intentional fence discontinuities. Use No. 2 AWG wire and bury it at least 18 inches (460 mm) below finished grade.

B. Protection at Crossings of Overhead Electrical Power Lines: Ground fence at location of crossing and at a maximum distance of 150 feet (45 m) on each side of crossing.

C. Fences Enclosing Electrical Power Distribution Equipment: Ground as required by IEEE C2 unless otherwise indicated.

D. Grounding Method: At each grounding location, drive a grounding rod vertically until the top is 6 inches (150 mm) below finished grade. Connect rod to fence with No. 6 AWG conductor. Connect conductor to each fence component at grounding location.

E. Bonding Method for Gates: Connect bonding jumper between gate post and gate frame.

F. Bonding to Lightning-Protection System: If fence terminates at lightning-protected building or structure, ground the fence and bond the fence grounding conductor to lightning-protection down conductor or lightning-protection grounding conductor, complying with NFPA 780.

3.7 INSTALLATION

A. Grounding Conductors: Route along shortest and straightest paths possible unless otherwise indicated or required by Code. Avoid obstructing access or placing conductors where they may be subjected to strain, impact, or damage.

B. Ground Bonding Common with Lightning Protection System: Comply with NFPA 780 and UL 96 when interconnecting with lightning protection system. Bond electrical power system ground directly to lightning protection system grounding conductor at closest point to electrical service grounding electrode. Use bonding conductor sized same as system grounding electrode conductor, and install in conduit.

C. Ground Rods: Drive rods until tops are 2 inches (50 mm) below finished floor or final grade unless otherwise indicated.

1. Interconnect ground rods with grounding electrode conductor below grade and as otherwise indicated. Make connections without exposing steel or damaging coating if any.

2. Use exothermic welds for all below-grade connections.

3. For grounding electrode system, install at least three rods spaced at least one-rod length from each other and located at least the same distance from other grounding electrodes, and connect to the service grounding electrode conductor.

D. Test Wells: Ground rod driven through drilled hole in bottom of handhole. Handholes are specified in Section 260543 "Underground Ducts and Raceways for Electrical Systems," and shall be at least 12 inches (300 mm) deep, with cover.

1. Install at least one test well for each service unless otherwise indicated. Install at the ground rod electrically closest to service entrance. Set top of test well flush with finished grade or floor.

E. Bonding Straps and Jumpers: Install in locations accessible for inspection and maintenance except where routed through short lengths of conduit.

1. Bonding to Structure: Bond straps directly to basic structure, taking care not to penetrate any adjacent parts.

2. Bonding to Equipment Mounted on Vibration Isolation Hangers and Supports: Install bonding so vibration is not transmitted to rigidly mounted equipment.

3. Use exothermic-welded connectors for outdoor locations; if a disconnect-type connection is required, use a bolted clamp.

F. Grounding and Bonding for Piping:

1. Metal Water Service Pipe: Install insulated copper grounding conductors, in conduit, from building's main service equipment, or grounding bus, to main metal water service entrances to building. Connect grounding conductors to main metal water service pipes; use a bolted clamp connector or bolt a lug-type connector to a pipe flange by using one of the lug bolts of the flange. Where a dielectric main water fitting is installed, connect grounding conductor on street side of fitting. Bond metal grounding conductor conduit or sleeve to conductor at each end.

2. Water Meter Piping: Use braided-type bonding jumpers to electrically bypass water meters. Connect to pipe with a bolted connector.

3. Bond each aboveground portion of gas piping system downstream from equipment shutoff valve.

G. Bonding Interior Metal Ducts: Bond metal air ducts to equipment grounding conductors of associated fans, blowers, electric heaters, and air cleaners. Install bonding jumper to bond across flexible duct connections to achieve continuity.

H. Grounding for Steel Building Structure: Install a driven ground rod at base of each corner column and at intermediate exterior columns at distances not more than 60 feet (18 m) apart.

I. Ground Ring: Install a grounding conductor, electrically connected to each building structure ground rod extending around the perimeter of area or item indicated.

1. Install tinned-copper conductor not less than 250kcmil for ground ring and for taps to building steel.

2. Bury ground ring not less than 24 inches (600 mm) from building's foundation.

J. Concrete-Encased Grounding Electrode (Ufer Ground): Fabricate according to NFPA 70; use a minimum of 50 feet (15 m) of bare copper conductor not smaller than 250 kcmil.

1. If concrete foundation is less than 50 feet (15 m) long, coil excess conductor within base of foundation.

2. Bond grounding conductor to reinforcing steel in at least four locations and to anchor bolts. Extend grounding conductor below grade and connect to building's grounding grid or to grounding electrode external to concrete.

K. Concrete-Encased Grounding Electrode (Ufer Ground): Fabricate according to NFPA 70; using electrically conductive coated steel reinforcing bars or rods, at least 20 feet (6.0 m) long. If reinforcing is in multiple pieces, connect together by the usual steel tie wires or exothermic welding to create the required length.

L. Connections: Make connections so possibility of galvanic action or electrolysis is minimized. Select connectors, connection hardware, conductors, and connection methods so metals in direct contact are galvanically compatible.

1. Use electroplated or hot-tin-coated materials to ensure high conductivity and to make contact points closer in order of galvanic series.

2. Make connections with clean, bare metal at points of contact.

3. Make aluminum-to-steel connections with stainless-steel separators and mechanical clamps.

4. Make aluminum-to-galvanized-steel connections with tin-plated copper jumpers and mechanical clamps.

5. Coat and seal connections having dissimilar metals with inert material to prevent future penetration of moisture to contact surfaces.

3.8 FIELD QUALITY CONTROL

A. Testing Agency: Owner will engage a qualified testing agency to perform tests and inspections.

B. Testing Agency: Engage a qualified testing agency to perform tests and inspections.

C. Manufacturer's Field Service: Engage a factory-authorized service representative to test and inspect components, assemblies, and equipment installations, including connections.

D. Perform tests and inspections.

E. Tests and Inspections:

1. After installing grounding system but before permanent electrical circuits have been energized, test for compliance with requirements.

2. Inspect physical and mechanical condition. Verify tightness of accessible, bolted, electrical connections with a calibrated torque wrench according to manufacturer's written instructions.

3. Test completed grounding system at each location where a maximum ground-resistance level is specified, at service disconnect enclosure grounding terminal, at ground test wells. Make tests at ground rods before any conductors are connected.

    a. Measure ground resistance no fewer than two full days after last trace of precipitation and without soil being moistened by any means other than natural drainage or seepage and without chemical treatment or other artificial means of reducing natural ground resistance.

    b. Perform tests by fall-of-potential method according to IEEE 81.

4. Prepare dimensioned Drawings locating each test well, ground rod and ground-rod assembly, and other grounding electrodes. Identify each by letter in alphabetical order, and key to the record of tests and observations. Include the number of rods driven and their depth at each location, and include observations of weather and other phenomena that may affect test results. Describe measures taken to improve test results.

F. Grounding system will be considered defective if it does not pass tests and inspections.

G. Prepare test and inspection reports.

H. Report measured ground resistances that exceed the following values:

1. Power and Lighting Equipment or System with Capacity of 500 kVA and Less: 10 ohms.

2. Power and Lighting Equipment or System with Capacity of 500 to 1000 kVA: 5 ohms.

3. Power and Lighting Equipment or System with Capacity More Than 1000 kVA: 3 ohms.

4. Power Distribution Units or Panelboards Serving Electronic Equipment: 1 ohm(s).

5. Substations and Pad-Mounted Equipment: 5 ohms.

6. Manhole Grounds: 10 ohms.

I. Excessive Ground Resistance: If resistance to ground exceeds specified values, notify Architect promptly and include recommendations to reduce ground resistance.

END OF SECTION 26 0526

SECTION 26 0529 - HANGERS AND SUPPORTS FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Steel slotted support systems.
2. Aluminum slotted support systems.
3. Nonmetallic slotted support systems.
4. Conduit and cable support devices.
5. Support for conductors in vertical conduit.
6. Structural steel for fabricated supports and restraints.
7. Mounting, anchoring, and attachment components, including powder-actuated fasteners, mechanical expansion anchors, concrete inserts, clamps, through bolts, toggle bolts, and hanger rods.
8. Fabricated metal equipment support assemblies.

B. Related Requirements:

1. Section 260548.16 "Seismic Controls for Electrical Systems" for products and installation requirements necessary for compliance with seismic criteria.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for the following:
    a. Slotted support systems, hardware, and accessories.
    b. Clamps.
    c. Hangers.
    d. Sockets.
    e. Eye nuts.
    f. Fasteners.

g. Anchors.

h. Saddles.

i. Brackets.

2. Include rated capacities and furnished specialties and accessories.

B. Shop Drawings: Signed and sealed by a qualified professional engineer in the state of the project. For fabrication and installation details for electrical hangers and support systems.

1. Hangers. Include product data for components.

2. Slotted support systems.

3. Equipment supports.

4. Vibration Isolation Base Details: Detail fabrication including anchorages and attachments to structure and to supported equipment. Include adjustable motor bases, rails, and frames for equipment mounting.

C. Delegated-Design Submittal: For hangers and supports for electrical systems.

1. Include design calculations and details of hangers.

2. Include design calculations for seismic restraints.

1.4 INFORMATIONAL SUBMITTALS

A. Coordination Drawings: Reflected ceiling plan(s) and other details, drawn to scale, on which the following items are shown and coordinated with each other, using input from installers of the items involved:

1. Suspended ceiling components.

2. Ductwork, piping, fittings, and supports.

3. Structural members to which hangers and supports will be attached.

4. Size and location of initial access modules for acoustical tile.

5. Items penetrating finished ceiling, including the following:

a. Luminaires.

b. Air outlets and inlets.

c. Speakers.

d. Sprinklers.

e. Access panels.

f. Projectors.

B. Seismic Qualification Data: Certificates, for hangers and supports for electrical equipment and systems, accessories, and components, from manufacturer.

1. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.

2. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.

3. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.

C. Welding certificates.

1.5 QUALITY ASSURANCE

A. Welding Qualifications: Qualify procedures and personnel according to AWS D1.1/D1.1M.

B. Welding Qualifications: Qualify procedures and personnel according to the following:

1. AWS D1.1/D1.1M.

2. AWS D1.2/D1.2M.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Delegated Design: Engage a qualified professional engineer, as defined in Section 014000 "Quality Requirements," to design hanger and support system.

B. Seismic Performance: Hangers and supports shall withstand the effects of earthquake motions determined according to ASCE/SEI 7.

1. The term "withstand" means "the supported equipment and systems will remain in place without separation of any parts when subjected to the seismic forces specified and the supported equipment and systems will be fully operational after the seismic event."

2. Component Importance Factor: 1.5.

C. Surface-Burning Characteristics: Comply with ASTM E84; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.

1. Flame Rating: Class 1.

2. Self-extinguishing according to ASTM D635.

2.2 SUPPORT, ANCHORAGE, AND ATTACHMENT COMPONENTS

A. Steel Slotted Support Systems: Preformed steel channels and angles with minimum 13/32-inch-(10-mm-) diameter holes at a maximum of 8 inches (200 mm) o.c. in at least one surface.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    a. Allied Tube & Conduit; a part of Atkore International.
    b. B-line, an Eaton business.
    c. CADDY; a brand of nVent.
    d. Flex-Strut Inc.
    e. Gripple Inc.
    f. Thomas & Betts Corporation; A Member of the ABB Group.
    g. Unistrut; Part of Atkore International.
2. Standard: Comply with MFMA-4 factory-fabricated components for field assembly.
3. Material for Channel, Fittings, and Accessories: Galvanized steel.
4. Channel Width: Selected for applicable load criteria or 1-5/8 inches (41.25 mm) or 1-1/4 inches (31.75 mm) or 13/16 inches (20.64 mm).
5. Metallic Coatings: Hot-dip galvanized after fabrication and applied according to MFMA-4.
6. Nonmetallic Coatings: Manufacturer's standard PVC, polyurethane, or polyester coating applied according to MFMA-4.
7. Painted Coatings: Manufacturer's standard painted coating applied according to MFMA-4.
8. Protect finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.

B. Aluminum Slotted Support Systems: Extruded-aluminum channels and angles with minimum 13/32-inch- (10-mm-) diameter holes at a maximum of 8 inches (200 mm) o.c. in at least one surface.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    a. Cooper Industries, Inc.
    b. Flex-Strut Inc.
    c. Thomas & Betts Corporation; A Member of the ABB Group.
    d. Unistrut; Part of Atkore International.
2. Standard: Comply with MFMA-4 factory-fabricated components for field assembly.
3. Channel Material: 6063-T5 aluminum alloy.

4. Fittings and Accessories Material: 5052-H32 aluminum alloy.

5. Channel Width: Selected for applicable load criteria or 1-5/8 inches (41.25 mm) or 1-1/4 inches (31.75 mm) or 13/16 inches (20.64 mm).

6. Nonmetallic Coatings: Manufacturer's standard PVC, polyurethane, or polyester coating applied according to MFMA-4.

7. Painted Coatings: Manufacturer's standard painted coating applied according to MFMA-4.

8. Protect finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.

C. Nonmetallic Slotted Support Systems: Structural-grade, factory-formed, glass-fiber-resin channels and angles with minimum 13/32-inch- (10-mm-) diameter holes at a maximum of 8 inches (200 mm) o.c., in at least one surface.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Allied Tube & Conduit; a part of Atkore International.

b. B-line, an Eaton business.

2. Standard: Comply with MFMA-4 factory-fabricated components for field assembly.

3. Channel Width: Selected for applicable load criteria or 1-5/8 inches (41.25 mm) or 1-1/4 inches (31.75 mm) or 13/16 inches (20.64 mm).

4. Fittings and Accessories: Products provided by channel and angle manufacturer and designed for use with those items.

5. Fitting and Accessory Materials: Same as those for channels and angles, except metal items may be stainless steel.

6. Rated Strength: Selected to suit applicable load criteria.

7. Protect finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.

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 nonarmored electrical conductors or cables in riser conduits. Plugs shall have number, size, and shape of conductor gripping pieces as required to suit individual conductors or cables supported. Body shall be made of malleable iron.

F. Structural Steel for Fabricated Supports and Restraints: ASTM A36/A36M 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. Powder-Actuated Fasteners: Threaded-steel stud, for use in hardened portland cement concrete, steel, or wood, with tension, shear, and pullout capacities appropriate for supported loads and building materials where used.

a. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1) Hilti, Inc.

2) Simpson Strong-Tie Co., Inc.

2. Mechanical-Expansion Anchors: Insert-wedge-type, zinc-coated steel, for use in hardened Portland cement concrete, with tension, shear, and pullout capacities appropriate for supported loads and building materials where used.

a. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1) B-line, an Eaton business.

2) Hilti, Inc.

3) ITW Ramset/Red Head; Illinois Tool Works, Inc.

3. Concrete Inserts: Steel or malleable-iron, slotted support system units are similar to MSS Type 18 units and comply with MFMA-4 or MSS SP-58.

4. Clamps for Attachment to Steel Structural Elements: MSS SP-58 units are suitable for attached structural element.

5. Through Bolts: Structural type, hex head, and high strength. Comply with ASTM F3125/F3125M, Grade A325 (Grade A325M).

6. Toggle Bolts: Stainless-steel springhead type.

7. Hanger Rods: Threaded steel.

2.3 FABRICATED METAL EQUIPMENT SUPPORT ASSEMBLIES

A. Description: Welded or bolted structural-steel shapes, shop or field fabricated to fit dimensions of supported equipment.

B. Materials: Comply with requirements in Section 055000 "Metal Fabrications" for steel shapes and plates.

PART 3 - EXECUTION

3.1 APPLICATION

A. Comply with the following standards for application and installation requirements of hangers and supports, except where requirements on Drawings or in this Section are stricter:

1. NECA 1.
2. NECA 101
3. NECA 102.
4. NECA 105.
5. NECA 111.

B. Comply with requirements in Section 078413 "Penetration Firestopping" for firestopping materials and installation for penetrations through fire-rated walls, ceilings, and assemblies.

C. Comply with requirements for raceways and boxes specified in Section 260533 "Raceways and Boxes for Electrical Systems."

D. Maximum Support Spacing and Minimum Hanger Rod Size for Raceways: Space supports for EMT, IMC, and RMC as required by NFPA 70, as scheduled in NECA 1, where its Table 1 lists maximum spacings that are less than those stated in NFPA 70. Minimum rod size shall be 1/4 inch (6 mm) in diameter.

E. Multiple Raceways or Cables: Install trapeze-type supports fabricated with steel slotted support system, sized so capacity can be increased by at least 25 percent in future without exceeding specified design load limits.

1. Secure raceways and cables to these supports with two-bolt conduit clamps.

F. Spring-steel clamps designed for supporting single conduits without bolts may be used for 1-1/2-inch (38-mm) and smaller raceways serving branch circuits and communication systems above suspended ceilings, and for fastening raceways to trapeze supports.

3.2 SUPPORT INSTALLATION

A. Comply with NECA 1 and NECA 101 for installation requirements except as specified in this article.

B. Raceway Support Methods: In addition to methods described in NECA 1, EMT IMC and RMC may be supported by openings through structure members, according to NFPA 70.

C. Strength of Support Assemblies: Where not indicated, select sizes of components so strength will be adequate to carry present and future static loads within specified loading limits. Minimum static design load used for strength determination shall be weight of supported components plus 200 lb (90 kg).

D. Mounting and Anchorage of Surface-Mounted Equipment and Components: Anchor and fasten electrical items and their supports to building structural elements by the following methods unless otherwise indicated by code:

1. To Wood: Fasten with lag screws or through bolts.
2. To New Concrete: Bolt to concrete inserts.

3. To Masonry: Approved toggle-type bolts on hollow masonry units and expansion anchor fasteners on solid masonry units.

4. To Existing Concrete: Expansion anchor fasteners.

5. Instead of expansion anchors, powder-actuated driven threaded studs provided with lock washers and nuts may be used in existing standard-weight concrete 4 inches (100 mm) thick or greater. Do not use for anchorage to lightweight-aggregate concrete or for slabs less than 4 inches (100 mm) thick.

6. To Steel: Welded threaded studs complying with AWS D1.1/D1.1M, with lock washers and nuts or Beam clamps (MSS SP-58, Type 19, 21, 23, 25, or 27), complying with MSS SP-69.

7. To Light Steel: Sheet metal screws.

8. Items Mounted on Hollow Walls and Nonstructural Building Surfaces: Mount cabinets, panelboards, disconnect switches, control enclosures, pull and junction boxes, transformers, and other devices on slotted-channel racks attached to substrate by means that comply with seismic-restraint strength and anchorage requirements.

E. Drill holes for expansion anchors in concrete at locations and to depths that avoid the need for reinforcing bars.

3.3 INSTALLATION OF FABRICATED METAL SUPPORTS

A. Comply with installation requirements in Section 055000 "Metal Fabrications" for site-fabricated metal supports.

B. Cut, fit, and place miscellaneous metal supports accurately in location, alignment, and elevation to support and anchor electrical materials and equipment.

C. Field Welding: Comply with AWS D1.1/D1.1M.

3.4 CONCRETE BASES

A. Construct concrete bases of dimensions indicated, but not less than 4 inches (100 mm) larger in both directions than supported unit, and so anchors will be a minimum of 10 bolt diameters from edge of the base.

B. Use 3000-psi (20.7-MPa), 28-day compressive-strength concrete. Concrete materials, reinforcement, and placement requirements are specified in Section 033000 "Cast-in-Place Concrete."

C. Anchor equipment to concrete base as follows:

1. Place and secure anchorage devices. Use supported equipment manufacturer's setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.

2. Install anchor bolts to elevations required for proper attachment to supported equipment.

3. Install anchor bolts according to anchor-bolt manufacturer's written instructions.

3.5 PAINTING

A. Touchup: Clean field welds and abraded areas of shop paint. Paint exposed areas immediately after erecting hangers and supports. Use same materials as used for shop painting. Comply with SSPC-PA 1 requirements for touching up field-painted surfaces.

1. Apply paint by brush or spray to provide minimum dry film thickness of 2.0 mils (0.05 mm).

B. Touchup: Comply with requirements in Section 099113 "Exterior Painting" Section 099123 "Interior Painting" and Section 099600 "High-Performance Coatings" for cleaning and touchup painting of field welds, bolted connections, and abraded areas of shop paint on miscellaneous metal.

C. Galvanized Surfaces: Clean welds, bolted connections, and abraded areas and apply galvanizing-repair paint to comply with ASTM A780.

END OF SECTION 260529

SECTION 260533 - RACEWAYS AND BOXES FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Metal conduits and fittings.
2. Nonmetallic conduits and fittings.
3. Metal wireways and auxiliary gutters.
4. Nonmetal wireways and auxiliary gutters.
5. Surface raceways.
6. Boxes, enclosures, and cabinets.
7. Handholes and boxes for exterior underground cabling.

B. Related Requirements:

1. Section 270528 "Pathways for Communications Systems" for conduits, wireways, surface pathways, innerduct, boxes, faceplate adapters, enclosures, cabinets, and handholes serving communications systems.

1.3 DEFINITIONS

A. ARC: Aluminum rigid conduit.

B. GRC: Galvanized rigid steel conduit.

C. IMC: Intermediate metal conduit.

1.4 ACTION SUBMITTALS

A. Product Data: For surface raceways, wireways and fittings, floor boxes, hinged-cover enclosures, and cabinets.

B. Sustainable Design Submittals:

C. Shop Drawings: For custom enclosures and cabinets. Include plans, elevations, sections, and attachment details.

1.5 INFORMATIONAL SUBMITTALS

A. Coordination Drawings: Conduit routing plans, drawn to scale, on which the following items are shown and coordinated with each other, using input from installers of items involved:

1. Structural members in paths of conduit groups with common supports.

2. HVAC and plumbing items and architectural features in paths of conduit groups with common supports.

B. Qualification Data: For professional engineer.

C. Seismic Qualification Data: Certificates, for enclosures, cabinets, and conduit racks and their mounting provisions, including those for internal components, from manufacturer.

1. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.

2. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.

3. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.

4. Detailed description of conduit support devices and interconnections on which the certification is based and their installation requirements.

D. Source quality-control reports.

PART 2 - PRODUCTS

2.1 METAL CONDUITS AND FITTINGS

A. Metal Conduit:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Allied Tube & Conduit; a part of Atkore International.

b. Opti-Com Manufacturing Network, Inc (OMNI).

c. O-Z/Gedney; a brand of Emerson Industrial Automation.

d. Plasti-Bond.

e. Southwire Company.

f. Thomas & Betts Corporation; A Member of the ABB Group.

g. Western Tube and Conduit Corporation.

h. Wheatland Tube Company.

2. Listing and Labeling: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

3. GRC: Comply with ANSI C80.1 and UL 6.

4. ARC: Comply with ANSI C80.5 and UL 6A.

5. IMC: Comply with ANSI C80.6 and UL 1242.

6. PVC-Coated Steel Conduit: PVC-coated rigid steel conduit.

   a. Comply with NEMA RN 1.

   b. Coating Thickness: 0.040 inch (1 mm), minimum.

7. EMT: Comply with ANSI C80.3 and UL 797.

8. FMC: Comply with UL 1; zinc-coated steel.

9. LFMC: Flexible steel conduit with PVC jacket and complying with UL 360.

B. Metal Fittings:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

   a. AFC Cable Systems; a part of Atkore International.

   b. Allied Tube & Conduit; a part of Atkore International.

   c. O-Z/Gedney; a brand of Emerson Industrial Automation.

   d. Plasti-Bond.

   e. Southwire Company.

   f. Thomas & Betts Corporation; A Member of the ABB Group.

   g. Wheatland Tube Company.

2. Comply with NEMA FB 1 and UL 514B.

3. Listing and Labeling: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

4. Fittings, General: Listed and labeled for type of conduit, location, and use.

5. Conduit Fittings for Hazardous (Classified) Locations: Comply with UL 1203 and NFPA 70.

6. Fittings for EMT:

   a. Material: Steel

   b. Type: Setscrew

7. Expansion Fittings: PVC or steel to match conduit type, complying with UL 651, rated for environmental conditions where installed, and including flexible external bonding jumper.

8. Coating for Fittings for PVC-Coated Conduit: Minimum thickness of 0.040 inch (1 mm), with overlapping sleeves protecting threaded joints.

C. Joint Compound for IMC, GRC, or ARC: Approved, as defined in NFPA 70, by authorities having jurisdiction for use in conduit assemblies, and compounded for use to lubricate and protect threaded conduit joints from corrosion and to enhance their conductivity.

2.2 NONMETALLIC CONDUITS AND FITTINGS

A. Nonmetallic Conduit:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. AFC Cable Systems; a part of Atkore International.

b. Cantex Inc.

c. CertainTeed Corporation.

d. Champion Fiberglass, Inc.

e. Hubbell Incorporated (Commercial and Industrial Group - RACO).

f. Thomas & Betts Corporation; A Member of the ABB Group.

g. Topaz Electric; a division of Topaz Lighting Corp.

h. United Fiberglass of America (UFA).

2. Listing and Labeling: Nonmetallic conduit shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

3. Fiberglass:

a. Comply with NEMA TC 14.

b. Comply with UL 2515 for aboveground raceways.

c. Comply with UL 2420 for belowground raceways.

4. ENT: Comply with NEMA TC 13 and UL 1653.

5. RNC: Type EPC-40-PVC or fiberglass complying with NEMA TC 2 and UL 651 unless otherwise indicated.

6. LFNC: Comply with UL 1660.

7. Rigid HDPE: Comply with UL 651A.

8. Continuous HDPE: Comply with UL 651A.

9. Coilable HDPE: Preassembled with conductors or cables, and complying with ASTM D3485.

10. RTRC: Comply with UL 2515A and NEMA TC 14.

B. Nonmetallic Fittings:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. AFC Cable Systems; a part of Atkore International.

b. CertainTeed Corporation.

c. Champion Fiberglass, Inc.

d. Condux International, Inc.

e. Hubbell Incorporated (Commercial and Industrial Group - RACO).

f. Thomas & Betts Corporation; A Member of the ABB Group.

g. United Fiberglass of America (UFA).

2. Fittings, General: Listed and labeled for type of conduit, location, and use.

3. Fittings for ENT and RNC: Comply with NEMA TC 3; match to conduit or tubing type and material.

a. Fittings for LFNC: Comply with UL 514B.

4. Solvents and Adhesives: As recommended by conduit manufacturer.

2.3 METAL WIREWAYS AND AUXILIARY GUTTERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. B-line, an Eaton business.

2. Hoffman; a brand of nVent.

3. MonoSystems, Inc.

4. Square D.

B. Description: Sheet metal, complying with UL 870 and NEMA 250, Type 1 or Type 3R or Type 4 or Type 12 as indicated, unless otherwise indicated, and sized according to NFPA 70.

1. Metal wireways installed outdoors shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

C. Fittings and Accessories: Include covers, couplings, offsets, elbows, expansion joints, adapters, hold-down straps, end caps, and other fittings to match and mate with wireways as required for complete system.

D. Wireway Covers: Hinged type or Screw-cover type or Flanged-and-gasketed type as appropriate for the type of enclosure.

E. Finish: Manufacturer's standard enamel finish.

2.4 NONMETALLIC WIREWAYS AND AUXILIARY GUTTERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Allied Moulded Products, Inc.

2. Hoffman; a brand of nVent.

3. Lamson & Sessions.

B. Listing and Labeling: Nonmetallic wireways and auxiliary gutters shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

C. Description: Fiberglass polyester, extruded and fabricated to required size and shape, without holes or knockouts. Cover shall be gasketed with oil-resistant gasket material and fastened with captive screws treated for corrosion resistance. Connections shall be flanged and have stainless-steel screws and oil-resistant gaskets.

D. Description: PVC, extruded and fabricated to required size and shape, and having snap-on cover, mechanically coupled connections, and plastic fasteners.

E. Fittings and Accessories: Couplings, offsets, elbows, expansion joints, adapters, hold-down straps, end caps, and other fittings shall match and mate with wireways as required for complete system.

F. Solvents and Adhesives: As recommended by conduit manufacturer.

2.5 BOXES, ENCLOSURES, AND CABINETS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Adalet.

2. Crouse-Hinds, an Eaton business.

3. EGS/Appleton Electric.

4. Erickson Electrical Equipment Company.

5. FSR Inc.

6. Hoffman; a brand of nVent.

7. Hubbell Incorporated.
8. Hubbell Incorporated (Commercial and Industrial Group - RACO).
9. Hubbell Incorporated (Commercial and Industrial Group - Wiring Device-Kellems).
10. Kraloy Fittings.
11. Milbank Manufacturing Co.
12. MonoSystems, Inc.
13. Oldcastle Enclosure Solutions.
14. O-Z/Gedney; a brand of Emerson Industrial Automation.
15. Plasti-Bond.
16. Spring City Electrical Manufacturing Company.
17. Stahlin Non-Metallic Enclosures.
18. Thomas & Betts Corporation; A Member of the ABB Group.
19. Topaz Electric; a division of Topaz Lighting Corp.
20. Wiremold / Legrand.

B. General Requirements for Boxes, Enclosures, and Cabinets: Boxes, enclosures, and cabinets installed in wet locations shall be listed for use in wet locations.

C. Sheet Metal Outlet and Device Boxes: Comply with NEMA OS 1 and UL 514A.

D. Cast-Metal Outlet and Device Boxes: Comply with NEMA FB 1, ferrous alloy, Type FD, with gasketed cover.

E. Nonmetallic Outlet and Device Boxes: Comply with NEMA OS 2 and UL 514C.

F. Metal Floor Boxes:

1. Material: Cast Metal.
2. Type: Fully adjustable.
3. Shape: Rectangular.
4. Listing and Labeling: Metal floor boxes shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

G. Nonmetallic Floor Boxes: Nonadjustable, rectangular.

1. Listing and Labeling: Nonmetallic floor boxes shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

H. Luminaire Outlet Boxes: Nonadjustable, designed for attachment of luminaire weighing 50 lb (23 kg). Outlet boxes designed for attachment of luminaires weighing more than 50 lb (23 kg) shall be listed and marked for the maximum allowable weight.

I. Paddle Fan Outlet Boxes: Nonadjustable, designed for attachment of paddle fan weighing 70 lb (32 kg).

1. Listing and Labeling: Paddle fan outlet boxes shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

J. Small Sheet Metal Pull and Junction Boxes: NEMA OS 1.

K. Cast-Metal Access, Pull, and Junction Boxes: Comply with NEMA FB 1 and UL 1773, galvanized, cast iron with gasketed cover.

L. Box extensions used to accommodate new building finishes shall be of same material as recessed box.

M. Device Box Dimensions: 4 11/16 inches square by 2-1/8 inches deep (119 mm square by 60 mm deep)

N. Gangable boxes are allowed.

O. Hinged-Cover Enclosures: Comply with UL 50 and NEMA 250, Type 1 or Type 3R or Type 4 Type 12 as indicated with continuous-hinge cover with flush latch unless otherwise indicated.

1. Metal Enclosures: Steel, finished inside and out with manufacturer's standard enamel.

2. Nonmetallic Enclosures: Fiberglass.

3. Interior Panels: Steel; all sides finished with manufacturer's standard enamel.

P. Cabinets:

1. NEMA 250, Type 1 or Type 3R as indicated galvanized-steel box with removable interior panel and removable front, finished inside and out with manufacturer's standard enamel.

2. Hinged door in front cover with flush latch and concealed hinge.

3. Key latch to match panelboards.

4. Metal barriers to separate wiring of different systems and voltage.

5. Accessory feet where required for freestanding equipment.

6. Nonmetallic cabinets shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

2.6 HANDHOLES AND BOXES FOR EXTERIOR UNDERGROUND WIRING

A. General Requirements for Handholes and Boxes:

1. Boxes and handholes for use in underground systems shall be designed and identified as defined in NFPA 70, for intended location and application.

2. Boxes installed in wet areas shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

B. Polymer-Concrete Handholes and Boxes with Polymer-Concrete Cover: Molded of sand and aggregate, bound together with polymer resin, and reinforced with steel, fiberglass, or a combination of the two.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Armorcast Products Company.

b. Hubbell Incorporated (Power Systems Group - Quazite).

c. Oldcastle Enclosure Solutions.

d. Oldcastle Precast, Inc.

2. Standard: Comply with SCTE 77.

3. Configuration: Designed for flush burial with integral closed bottom unless otherwise indicated.

4. Cover: Weatherproof, secured by tamper-resistant locking devices and having structural load rating consistent with enclosure and handhole location.

5. Cover Finish: Nonskid finish shall have a minimum coefficient of friction of 0.50.

6. Cover Legend: Molded lettering, "ELECTRIC."

7. Conduit Entrance Provisions: Conduit-terminating fittings shall mate with entering ducts for secure, fixed installation in enclosure wall.

8. Handholes 12 Inches Wide by 24 Inches Long (300 mm Wide by 600 mm Long) and Larger: Have inserts for cable racks and pulling-in irons installed before concrete is poured.

C. Fiberglass Handholes and Boxes: Molded of fiberglass-reinforced polyester resin, with frame and covers of cast iron or fiberglass.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Armorcast Products Company.

b. Hubbell Incorporated (Power Systems Group - Quazite).

c. Nordic Fiberglass, Inc.

d. Oldcastle Enclosure Solutions.

e. Oldcastle Enclosure Solutions.

f. Oldcastle Precast, Inc.

2. Standard: Comply with SCTE 77.

3. Color of Frame and Cover: Gray.

4. Configuration: Designed for flush burial with integral closed bottom unless otherwise indicated.

5. Cover: Weatherproof, secured by tamper-resistant locking devices and having structural load rating consistent with enclosure and handhole location.

6. Cover Finish: Nonskid finish shall have a minimum coefficient of friction of 0.50.

7. Cover Legend: Molded lettering, "ELECTRIC."

8. Conduit Entrance Provisions: Conduit-terminating fittings shall mate with entering ducts for secure, fixed installation in enclosure wall.

9. Handholes 12 Inches Wide by 24 Inches Long (300 mm Wide by 600 mm Long) and Larger: Have inserts for cable racks and pulling-in irons installed before concrete is poured.

2.7 SOURCE QUALITY CONTROL FOR UNDERGROUND ENCLOSURES

A. Handhole and Pull-Box Prototype Test: Test prototypes of handholes and boxes for compliance with SCTE 77. Strength tests shall be for specified tier ratings of products supplied.

1. Tests of materials shall be performed by an independent testing agency.

2. Strength tests of complete boxes and covers shall be by either an independent testing agency or manufacturer. A qualified registered professional engineer shall certify tests by manufacturer.

3. Testing machine pressure gages shall have current calibration certification complying with ISO 9000 and ISO 10012 and traceable to NIST standards.

PART 3 - EXECUTION

3.1 RACEWAY APPLICATION

A. Outdoors: Apply raceway products as specified below unless otherwise indicated:

1. Exposed Conduit: GRC IMC

2. Concealed Conduit, Aboveground: GRC or IMC or EMT or RNC, Type EPC-40-PVC.

3. Underground Conduit: RNC, Type EPC-40-PVC or Type EPC-80-PVC, direct buried or concrete-encased as indicated. All elbows over 22 degrees shall be PVC coated RGS conduit.

4. Connection to Vibrating Equipment (Including Transformers and Hydraulic, Pneumatic, Electric Solenoid, or Motor-Driven Equipment): LFMC.

5. Boxes and Enclosures, Aboveground: NEMA 250, Type 3R.

B. Indoors: Apply raceway products as specified below unless otherwise indicated:

1. Exposed, Not Subject to Physical Damage: EMT.

2. Exposed and Subject to Severe Physical Damage: GRC or IMC. Raceway locations include the following:

a. Tunnels and corridors used for traffic of mechanized carts, forklifts, and pallet-handling units.

b. Mechanical rooms or tunnels below 4’ A.F.F.

3. Concealed in Ceilings and Interior Walls and Partitions: EMT.

4. Connection to Vibrating Equipment (Including Transformers and Hydraulic, Pneumatic, Electric Solenoid, or Motor-Driven Equipment): FMC, except use LFMC in damp or wet locations.

5. Damp or Wet Locations: GRC or IMC.

6. Boxes and Enclosures: NEMA 250, Type 1, except use NEMA 250, Type 4 stainless steel in institutional and commercial kitchens and damp or wet locations.

C. Minimum Raceway Size: 1/2-inch (21-mm) trade size for indoor installations and 1 inch for outdoor installations.

D. Raceway Fittings: Compatible with raceways and suitable for use and location.

1. Rigid and Intermediate Steel Conduit: Use threaded rigid steel conduit fittings unless otherwise indicated. Comply with NEMA FB 2.10.

2. PVC Externally Coated, Rigid Steel Conduits: Use only fittings listed for use with this type of conduit. Patch and seal all joints, nicks, and scrapes in PVC coating after installing conduits and fittings. Use sealant recommended by fitting manufacturer and apply in thickness and number of coats recommended by manufacturer.

3. EMT: Use setscrew steel fittings. Comply with NEMA FB 2.10.

4. Flexible Conduit: Use only fittings listed for use with flexible conduit. Comply with NEMA FB 2.20.

E. Install nonferrous conduit or tubing for circuits operating above 60 Hz. Where aluminum raceways are installed for such circuits and pass through concrete, install in nonmetallic sleeve.

F. Do not install aluminum conduits, boxes, or fittings in contact with concrete or earth.

G. Install surface raceways only where indicated on Drawings.

H. Do not install nonmetallic conduit where ambient temperature exceeds 120 deg F (49 deg C)

3.2 INSTALLATION

A. Comply with requirements in Section 260529 "Hangers and Supports for Electrical Systems" for hangers and supports.

B. Comply with NECA 1 and NECA 101 for installation requirements except where requirements on Drawings or in this article are stricter. Comply with NECA 102 for aluminum conduits. Comply with NFPA 70 limitations for types of raceways allowed in specific occupancies and number of floors.

C. Do not install raceways or electrical items on any "explosion-relief" walls or rotating equipment.

D. Do not fasten conduits onto the bottom side of a metal deck roof.

E. Keep raceways at least 6 inches (150 mm) away from parallel runs of flues and steam or hot-water pipes. Install horizontal raceway runs above water and steam piping.

F. Complete raceway installation before starting conductor installation.

G. Arrange stub-ups so curved portions of bends are not visible above finished slab.

H. Install no more than the equivalent of three 90-degree bends in any conduit run except for control wiring conduits, for which fewer bends are allowed. Support within 12 inches (300 mm) of changes in direction.

I. Make bends in raceway using large-radius preformed ells. Field bending shall be according to NFPA 70 minimum radii requirements. Use only equipment specifically designed for material and size involved. Data Conduits shall use long sweep elbows.

J. Conceal conduit within finished walls, ceilings, and floors unless otherwise indicated. Install conduits parallel or perpendicular to building lines.

K. Support conduit within 12 inches (300 mm) of enclosures to which attached.

L. Any bend in buried PVC conduit over 22 degrees shall be Fiberglass or PVC coated GRC. Use threaded adapters to PVC.

M. Conduits embedded in concrete shall be PVC.

N. Use PVC coated GRC to penetrate any wall or manhole opening.

O. Raceways Embedded in Slabs:

1. Run conduit larger than 1-inch (27-mm) trade size, parallel or at right angles to main reinforcement. Where at right angles to reinforcement, place conduit close to slab support. Secure raceways to reinforcement at maximum 10-foot (3-m) intervals.

2. Arrange raceways to cross building expansion joints at right angles with expansion fittings.

3. Arrange raceways to keep a minimum of 2 inches (50 mm) of concrete cover in all directions.

4. Do not embed threadless fittings in concrete unless specifically approved by Architect for each specific location.

5. Change from ENT to GRC before rising above floor.

P. Stub-Ups to Above Recessed Ceilings:

1. Use EMT, IMC, or RMC for raceways.

2. Use a conduit bushing or insulated fitting to terminate stub-ups not terminated in hubs or in an enclosure.

Q. Threaded Conduit Joints, Exposed to Wet, Damp, Corrosive, or Outdoor Conditions: Apply listed compound to threads of raceway and fittings before making up joints. Follow compound manufacturer's written instructions.

R. Coat field-cut threads on PVC-coated raceway with a corrosion-preventing conductive compound prior to assembly.

S. Raceway Terminations at Locations Subject to Moisture or Vibration: Use insulating bushings to protect conductors including conductors smaller than No. 4 AWG.

T. Terminate threaded conduits into threaded hubs or with locknuts on inside and outside of boxes or cabinets. Install bushings on conduits up to 1-1/4-inch (35mm) trade size and insulated throat metal bushings on 1-1/2-inch (41-mm) trade size and larger conduits terminated with locknuts. Install insulated throat metal grounding bushings on service conduits.

U. Install raceways square to the enclosure and terminate at enclosures with locknuts. Install locknuts hand tight plus 1/4 turn more.

V. Do not rely on locknuts to penetrate nonconductive coatings on enclosures. Remove coatings in the locknut area prior to assembling conduit to enclosure to assure a continuous ground path.

W. Cut conduit perpendicular to the length. For conduits 2-inch (53-mm) trade size and larger, use roll cutter or a guide to make cut straight and perpendicular to the length.

X. Install pull wires in empty raceways. Use polypropylene or monofilament plastic line with not less than 200-lb (90-kg) tensile strength. Leave at least 12 inches (300 mm) of slack at each end of pull wire. Cap underground raceways designated as spare above grade alongside raceways in use.

Y. Surface Raceways:

1. Install surface raceway with a minimum 2-inch (50-mm) radius control at bend points.

2. Secure surface raceway with screws or other anchor-type devices at intervals not exceeding 48 inches (1200 mm) and with no less than two supports per straight raceway section. Support surface raceway according to manufacturer's written instructions. Tape and glue are not acceptable support methods.

Z. Install raceway sealing fittings at accessible locations according to NFPA 70 and fill them with listed sealing compound. For concealed raceways, install each fitting in a flush steel box with a blank cover plate having a finish similar to that of adjacent plates or surfaces. Install raceway sealing fittings according to NFPA 70.

AA. Install devices to seal raceway interiors at accessible locations. Locate seals so no fittings or boxes are between the seal and the following changes of environments. Seal the interior of all raceways at the following points:

1. Where conduits pass from warm to cold locations, such as boundaries of refrigerated spaces.

2. Where an underground service raceway enters a building or structure.

3. Conduit extending from interior to exterior of building.

4. Conduit extending into pressurized duct and equipment.

5. Conduit extending into pressurized zones that are automatically controlled to maintain different pressure set points.

6. Where otherwise required by NFPA 70.

BB. Comply with manufacturer's written instructions for solvent welding RNC and fittings.

CC. Expansion-Joint Fittings:

1. Install in each run of aboveground RNC that is located where environmental temperature change may exceed 30 deg F (17 deg C) and that has straight-run length that exceeds 25 feet (7.6 m). Install in each run of aboveground RMC and EMT conduit that is located where environmental temperature change may exceed 100 deg F (55 deg C) and that has straight-run length that exceeds 100 feet (30 m).

2. Install type and quantity of fittings that accommodate temperature change listed for each of the following locations:

   a. Outdoor Locations Not Exposed to Direct Sunlight: 125 deg F (70 deg C) temperature change.

   b. Outdoor Locations Exposed to Direct Sunlight: 155 deg F (86 deg C) temperature change.

   c. Indoor Spaces Connected with Outdoors without Physical Separation: 125 deg F (70 deg C) temperature change.

   d. Attics: 135 deg F (75 deg C) temperature change.

3. Install fitting(s) that provide expansion and contraction for at least 0.00041 inch per foot of length of straight run per deg F (0.06 mm per meter of length of straight run per deg C) of temperature change for PVC conduits. Install fitting(s) that provide expansion and contraction for at least 0.000078 inch per foot of length of straight run per deg F (0.0115 mm per meter of length of straight run per deg C) of temperature change for metal conduits.

4. Install expansion fittings at all locations where conduits cross building or structure expansion joints.

5. Install each expansion-joint fitting with position, mounting, and piston setting selected according to manufacturer's written instructions for conditions at specific location at time of installation. Install conduit supports to allow for expansion movement.

DD. Flexible Conduit Connections: Comply with NEMA RV 3. Use a maximum of 36 inches (915 mm) of flexible conduit for recessed and semirecessed luminaires, equipment subject to vibration, noise transmission, or movement; and for transformers and motors.

1. Use LFMC in damp or wet locations whether or not subject to severe physical damage.

EE. Mount boxes at heights indicated on Drawings. If mounting heights of boxes are not individually indicated, give priority to ADA requirements. Install boxes with height measured to center of box unless otherwise indicated.

FF. Recessed Boxes in Masonry Walls: Saw-cut opening for box in center of cell of masonry block, and install box flush with surface of wall. Prepare block surfaces to provide a flat surface for a raintight connection between box and cover plate or supported equipment and box.

GG. Horizontally separate boxes mounted on opposite sides of walls so they are not in the same vertical channel.

HH. Locate boxes so that cover or plate will not span different building finishes.

II. Support boxes of three gangs or more from more than one side by spanning two framing members or mounting on brackets specifically designed for the purpose.

JJ. Fasten junction and pull boxes to or support from building structure. Do not support boxes by conduits.

KK. Set metal floor boxes level and flush with finished floor surface.

LL. Set nonmetallic floor boxes level. Trim after installation to fit flush with finished floor surface.

3.3 INSTALLATION OF UNDERGROUND CONDUIT

A. Direct-Buried Conduit:

1. Excavate trench bottom to provide firm and uniform support for conduit. Prepare trench bottom as specified in Section 312000 "Earth Moving" for pipe less than 6 inches (150 mm) in nominal diameter.

2. Install backfill as specified in Section 312000 "Earth Moving."

3. After installing conduit, backfill and compact. Start at tie-in point, and work toward end of conduit run, leaving conduit at end of run free to move with expansion and contraction as temperature changes during this process. Firmly hand tamp backfill around conduit to provide maximum supporting strength. After placing controlled backfill to within 12 inches (300 mm) of finished grade, make final conduit connection at end of run and complete backfilling with normal compaction as specified in Section 312000 "Earth Moving."

4. Install manufactured duct elbows for stub-ups at poles and equipment and at building entrances through floor unless otherwise indicated. Encase elbows for stub-up ducts throughout length of elbow.

5. Install manufactured PVC coated rigid steel conduit elbows for stub-ups at poles and equipment and at building entrances through floor.

    a. Couple steel conduits to ducts with adapters designed for this purpose, and encase coupling with 3 inches (75 mm) of concrete for a minimum of 12 inches (300 mm) on each side of the coupling.

    b. For stub-ups at equipment mounted on outdoor concrete bases and where conduits penetrate building foundations, extend steel conduit horizontally a minimum of 60 inches (1500 mm) from edge of foundation or equipment base. Install insulated grounding bushings on terminations at equipment.

6. Warning Planks: Bury warning planks approximately 12 inches (300 mm) above direct-buried conduits but a minimum of 6 inches (150 mm) below grade. Align planks along centerline of conduit.

7. Underground Warning Tape: Comply with requirements in Section 260553 "Identification for Electrical Systems."

3.4 INSTALLATION OF UNDERGROUND HANDHOLES AND BOXES

A. Install handholes and boxes level and plumb and with orientation and depth coordinated with connecting conduits to minimize bends and deflections required for proper entrances.

B. Unless otherwise indicated, support units on a level bed of crushed stone or gravel, graded from 1/2-inch (12.5-mm) sieve to No. 4 (4.75-mm) sieve and compacted to same density as adjacent undisturbed earth.

C. Elevation: In paved areas, set so cover surface will be flush with finished grade. Set covers of other enclosures 1 inch (25 mm) above finished grade.

D. Install handholes with bottom below frost line, 36” below grade.

E. Install removable hardware, including pulling eyes, cable stanchions, cable arms, and insulators, as required for installation and support of cables and conductors and as indicated. Select arm lengths to be long enough to provide spare space for future cables but short enough to preserve adequate working clearances in enclosure.

F. Field-cut openings for conduits according to enclosure manufacturer's written instructions. Cut wall of enclosure with a tool designed for material to be cut. Size holes for terminating fittings to be used, and seal around penetrations after fittings are installed.

3.5 SLEEVE AND SLEEVE-SEAL INSTALLATION FOR ELECTRICAL PENETRATIONS

A. Install 0sleeves and sleeve seals at penetrations of exterior floor and wall assemblies. Comply with requirements in Section 260544 "Sleeves and Sleeve Seals for Electrical Raceways and Cabling."

3.6 FIRESTOPPING

A. Install firestopping at penetrations of fire-rated floor and wall assemblies. Comply with requirements in Section 078413 "Penetration Firestopping."

3.7 PROTECTION

A. Protect coatings, finishes, and cabinets from damage and deterioration.

1. Repair damage to galvanized finishes with zinc-rich paint recommended by manufacturer.

2. Repair damage to PVC coatings or paint finishes with matching touchup coating recommended by manufacturer.

END OF SECTION 26 0533

SECTION 260544 – SLEEVES AND SLEEVE SEALS FOR ELECTRICAL RACEWAYS AND CABLING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Sleeves for raceway and cable penetration of non-fire-rated construction walls and floors.
2. Sleeve-seal systems.
3. Sleeve-seal fittings.
4. Grout.
5. Silicone sealants.

B. Related Requirements:

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

PART 2 - PRODUCTS

2.1 SLEEVES

A. Wall Sleeves:

1. Steel Pipe Sleeves: ASTM A53/A53M, Type E, Grade B, Schedule 40, zinc coated, plain ends.
2. Cast-Iron Pipe Sleeves: Cast or fabricated "wall pipe," equivalent to ductile-iron pressure pipe, with plain ends and integral waterstop unless otherwise indicated.

B. Sleeves for Conduits Penetrating Non-Fire-Rated Gypsum Board Assemblies: Galvanized-steel sheet; 0.0239-inch (0.6-mm) minimum thickness; round tube closed with welded longitudinal joint, with tabs for screw-fastening the sleeve to the board.

C. PVC-Pipe Sleeves: ASTM D1785, Schedule 40.

D. Molded-PVC Sleeves: With nailing flange for attaching to wooden forms.

E. Molded-PE or -PP Sleeves: Removable, tapered-cup shaped, and smooth outer surface with nailing flange for attaching to wooden forms.

F. Sleeves for Rectangular Openings:

1. Material: Galvanized sheet steel.

2. Minimum Metal Thickness:

   a. For sleeve cross-section rectangle perimeter less than 50 inches (1270 mm) and with no side larger than 16 inches (400 mm), thickness shall be 0.052 inch (1.3 mm).

   b. For sleeve cross-section rectangle perimeter 50 inches (1270 mm) or more and one or more sides larger than 16 inches (400 mm), thickness shall be 0.138 inch (3.5 mm).

2.2 SLEEVE-SEAL SYSTEMS

A. Description: Modular sealing device, designed for field assembly, to fill annular space between sleeve and raceway or cable.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

   a. Advance Products & Systems, Inc.

   b. BWM Company.

   c. Flexicraft Industries.

   d. Metraflex Company (The).

   e. OZ Gedney.

   f. Pipeline Seal and Insulator, Inc.

2. Sealing Elements: Nitrile (Buna N) rubber interlocking links shaped to fit surface of pipe. Include type and number required for pipe material and size of pipe.

3. Pressure Plates: Stainless steel.

4. Connecting Bolts and Nuts: Stainless steel of length required to secure pressure plates to sealing elements.

5. Any sealing devices in walls shall seal against PVC coated GRC through wall. Thence continue with PVC conduit.

2.3 SLEEVE-SEAL FITTINGS

A. Description: Manufactured plastic, sleeve-type, waterstop assembly made for embedding in concrete slab or wall. Unit shall have plastic or rubber waterstop collar with center opening to match piping OD.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

   a. HOLDRITE; Reliance Worldwide Company.

2.4 GROUT

A. Description: Nonshrink; recommended for interior and exterior sealing openings in non-fire-rated walls or floors.

B. Standard: ASTM C1107/C1107M, Grade B, post-hardening and volume-adjusting, dry, hydraulic-cement grout.

C. Design Mix: 5000-psi (34.5-MPa), 28-day compressive strength.

D. Packaging: Premixed and factory packaged.

2.5 SILICONE SEALANTS

A. Silicone Sealants: Single-component, silicone-based, neutral-curing elastomeric sealants of grade indicated below.

1. Grade: Pourable (self-leveling) formulation for openings in floors and other horizontal surfaces that are not fire rated.

B. Silicone Foams: Multicomponent, silicone-based liquid elastomers that, when mixed, expand and cure in place to produce a flexible, nonshrinking foam.

PART 3 - EXECUTION

3.1 SLEEVE INSTALLATION FOR NON-FIRE-RATED ELECTRICAL PENETRATIONS

A. Comply with NECA 1.

B. Comply with NEMA VE 2 for cable tray and cable penetrations.

C. Sleeves for Conduits Penetrating Above-Grade Non-Fire-Rated Concrete and Masonry-Unit Floors and Walls:

1. Interior Penetrations of Non-Fire-Rated Walls and Floors:

a. Seal annular space between sleeve and raceway or cable, using joint sealant appropriate for size, depth, and location of joint. Comply with requirements in Section 079200 "Joint Sealants."

b. Seal space outside of sleeves with mortar or grout. Pack sealing material solidly between sleeve and wall so no voids remain. Tool exposed surfaces smooth; protect material while curing.

2. Use pipe sleeves unless penetration arrangement requires rectangular sleeved opening.

3. Size pipe sleeves to provide 1/4-inch (6.4-mm) annular clear space between sleeve and raceway or cable unless sleeve seal is to be installed or unless seismic criteria require different clearance.

4. Install sleeves for wall penetrations unless core-drilled holes or formed openings are used. Install sleeves during erection of walls. Cut sleeves to length for mounting flush with both surfaces of walls. Deburr after cutting.

5. Install sleeves for floor penetrations. Extend sleeves installed in floors 2 inches (50 mm) above finished floor level. Install sleeves during erection of floors.

D. Sleeves for Conduits Penetrating Non-Fire-Rated Gypsum Board Assemblies:

1. Use circular metal sleeves unless penetration arrangement requires rectangular sleeved opening.

2. Seal space outside of sleeves with approved joint compound for gypsum board assemblies.

E. Roof-Penetration Sleeves: Seal penetration of individual raceways and cables with flexible boot-type flashing units applied in coordination with roofing work.

F. Aboveground, Exterior-Wall Penetrations: Seal penetrations using steel pipe sleeves and mechanical sleeve seals. Select sleeve size to allow for 1-inch (25-mm) annular clear space between pipe and sleeve for installing mechanical sleeve seals.

G. Underground, Exterior-Wall and Floor Penetrations: Install cast-iron pipe sleeves. Size sleeves to allow for 1-inch (25-mm) annular clear space between raceway or cable and sleeve for installing sleeve-seal system.

3.2 SLEEVE-SEAL-SYSTEM INSTALLATION

A. Install sleeve-seal systems in sleeves in exterior concrete walls and slabs-on-grade at raceway entries into building.

B. Install type and number of sealing elements recommended by manufacturer for raceway or cable material and size. Position raceway or cable in center of sleeve. Assemble mechanical sleeve seals and install in annular space between raceway or cable and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make watertight seal.

3.3 SLEEVE-SEAL-FITTING INSTALLATION

A. Install sleeve-seal fittings in new walls and slabs as they are constructed.

B. Assemble fitting components of length to be flush with both surfaces of concrete slabs and walls. Position waterstop flange to be centered in concrete slab or wall.

C. Secure nailing flanges to concrete forms.

D. Using grout, seal the space around outside of sleeve-seal fittings.

END OF SECTION 26 0544

SECTION 26 0548.16 - SEISMIC CONTROLS FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Restraint channel bracings.
2. Restraint cables.
3. Seismic-restraint accessories.
4. Mechanical anchor bolts.
5. Adhesive anchor bolts.

B. Related Requirements:

1. Section 260529 "Hangers and Supports for Electrical Systems" for commonly used electrical supports and installation requirements.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Illustrate and indicate style, material, strength, fastening provision, and finish for each type and size of seismic-restraint component used.
    a. Tabulate types and sizes of seismic restraints, complete with report numbers and rated strength in tension and shear as evaluated by an evaluation service member of ICC-ES.
    b. Annotate to indicate application of each product submitted and compliance with requirements.

B. Delegated-Design Submittal: For each seismic-restraint device and building structural connections to support electrical equipment and conduits. Conduit trapeze support details with their associated support means to the structure shall be included in the delegated design submittal. All conduit over 1 ¼" shall be restrained and detailed for its support and seismic restraint. All equipment shall be seismically braced and anchored to the structure and the design for such shall be included in the delegated design.

1. For vibration isolation and seismic-restraint details indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer (registered in the State of Utah) responsible for their preparation.

2. "Basis for Design" report: Statement from the registered design professional that the design complies with the requirements of the ASCE 7-16 Chapter 13, IBC (current adopted edition). In addition, the basis for compliance must also be noted, as listed below:
3. Project specific design documentation prepared and submitted by a registered design professional (ASCE 7, 13.2.1.1)
4. Include design calculations and details for selecting building structural connections and seismic restraints complying with performance requirements, design criteria, and analysis data signed and sealed by the qualified professional engineer (State of Utah) responsible for their preparation.
5. Design Calculations: Calculate static and dynamic loading due to equipment weight, operation, and seismic forces required to select connection to building structure and seismic restraints and for designing vibration isolation bases.
    a. Coordinate design calculations with wind load calculations required for equipment mounted outdoors. Comply with requirements in other Sections for equipment mounted outdoors.
6. Riser Supports: Include riser diagrams and calculations showing anticipated expansion and contraction at each support point, initial and final loads on building structure, spring deflection changes, and seismic loads. Include certification that riser system was examined for excessive stress and that none exists.
7. Seismic and Wind-Restraint Details:
    a. Design Analysis: To support selection and arrangement of seismic and wind restraints. Include calculations of combined tensile and shear loads.
    b. Details: Indicate fabrication and arrangement. Detail attachments of restraints to the restrained items and to the structure. Show attachment locations, methods, and spacings. Identify components, list their strengths, and indicate directions and values of forces transmitted to the structure during seismic events. Indicate association with vibration isolation devices.
    c. Coordinate seismic-restraint and vibration isolation details with wind-restraint details required for equipment mounted outdoors. Comply with requirements in other Sections for equipment mounted outdoors.
    d. Preapproval and Evaluation Documentation: By an evaluation service member of ICC-ES showing maximum ratings of restraint items and the basis for approval (tests or calculations).
    e. Coordinate seismic-restraint and vibration isolation details with wind-restraint details required for equipment mounted outdoors. Comply with requirements in other Sections for equipment mounted outdoors.
    f. Preapproval and Evaluation Documentation: By an evaluation service member of ICC-ES, showing maximum ratings of restraint items and the basis for approval (tests or calculations).

1.4 INFORMATIONAL SUBMITTALS

A. Coordination Drawings: Show coordination of seismic bracing for electrical components with other systems and equipment in the vicinity, including other supports and seismic restraints. Electrical components include:

1. Luminaires.

2. Panelboards.

3. Conduit supports, hangers, attachments, etc.

B. Qualification Data: For professional engineer.

C. Welding certificates.

D. Field quality-control reports.

1.5 QUALITY ASSURANCE

A. Testing Agency Qualifications: An independent agency, with the experience and capability to conduct the testing indicated and that is acceptable to authorities having jurisdiction.

B. Comply with seismic-restraint requirements in the IBC unless requirements in this Section are more stringent.

C. Welding Qualifications: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."

D. Seismic-restraint devices shall have horizontal and vertical load testing and analysis. They shall bear anchorage preapproval from OSHPD in addition to preapproval, showing maximum seismic-restraint ratings, by ICC-ES or another agency acceptable to authorities having jurisdiction. Ratings based on independent testing are preferred to ratings based on calculations. If preapproved ratings are not available, submittals based on independent testing are preferred. Calculations (including combining shear and tensile loads) that support seismic-restraint designs must be signed and sealed by a qualified professional engineer.

E. Comply with NFPA 70.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Wind-Restraint Loading:

1. Basic Wind Speed: 115.

2. Building Classification Category: III.

3. Minimum 10 lb/sq. ft. (48.8 kg/sq. m) multiplied by maximum area of component projected on vertical plane normal to wind direction and 45 degrees either side of normal.

B. Seismic-Restraint Loading:

1. See structural drawings for Seismic-Restraint Loading. Rated strengths, features, and applications shall be as defined in reports by an evaluation service member of ICC-ES.

2. Site Class as Defined in the IBC: D.

3. Assigned Seismic Use Group or Building Category as Defined in the IBC: III.

a. Component Importance Factor: 1.5.

b. Component Response Modification Factor: 1.5.

c. Component Amplification Factor: 2.5.

4. Design Spectral Response Acceleration at Short Periods (0.2 Second): see Structural Drawings.

5. Design Spectral Response Acceleration at 1.0-Second Period: see Structural Drawings.

2.2 RESTRAINT CHANNEL BRACINGS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. B-line, an Eaton business.

2. Hilti, Inc.

3. Mason Industries, Inc.

4. Unistrut; Part of Atkore International.

B. Description: MFMA-4, shop- or field-fabricated bracing assembly made of slotted steel channels with accessories for attachment to braced component at one end and to building structure at the other end, with other matching components, and with corrosion-resistant coating; rated in tension, compression, and torsion forces.

2.3 RESTRAINT CABLES

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. CADDY; a brand of nVent.

2. Gripple Inc.

3. Kinetics Noise Control, Inc.

4. Vibration Mountings & Controls, Inc.

B. Restraint Cables: ASTM A492 stainless-steel cables. End connections made of steel assemblies with thimbles, brackets, swivel, and bolts designed for restraining cable service; with a minimum of two clamping bolts for cable engagement.

2.4 SEISMIC-RESTRAINT ACCESSORIES

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. B-line, an Eaton business.

2. Kinetics Noise Control, Inc.

3. Mason Industries, Inc.

B. Hanger-Rod Stiffener: Steel tube or steel slotted-support-system sleeve with internally bolted connections to hanger rod.

C. Hinged and Swivel Brace Attachments: Multifunctional steel connectors for attaching hangers to rigid channel bracings and restraint cables.

D. Bushings for Floor-Mounted Equipment Anchor Bolts: Neoprene bushings designed for rigid equipment mountings and matched to type and size of anchor bolts and studs.

E. Bushing Assemblies for Wall-Mounted Equipment Anchorage: Assemblies of neoprene elements and steel sleeves designed for rigid equipment mountings and matched to type and size of attachment devices used.

F. Resilient Isolation Washers and Bushings: One-piece, molded, oil- and water-resistant neoprene, with a flat washer face.

2.5 MECHANICAL ANCHOR BOLTS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. B-line, an Eaton business.

2. Hilti, Inc.

3. Kinetics Noise Control, Inc.

4. Mason Industries, Inc.

B. Mechanical Anchor Bolts: Drilled-in and stud-wedge or female-wedge type in zinc-coated steel for interior applications and stainless steel for exterior applications. Select anchor bolts with strength required for anchor and as tested according to ASTM E488.

2.6 ADHESIVE ANCHOR BOLTS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Hilti, Inc.

2. Kinetics Noise Control, Inc.

3. Mason Industries, Inc.

B. Adhesive Anchor Bolts: Drilled-in and capsule anchor system containing PVC or urethane methacrylate-based resin and accelerator, or injected polymer or hybrid mortar adhesive. Provide anchor bolts and hardware with zinc-coated steel for interior applications and stainless steel for exterior applications. Select anchor bolts with strength required for anchor and as tested according to ASTM E488.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas and equipment to receive vibration isolation and seismic-control devices for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.

B. Examine roughing-in for reinforcement and cast-in-place anchors to verify actual locations before installation.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 APPLICATIONS

A. Multiple Raceways or Cables: Secure raceways and cables to trapeze member with clamps approved for application by an evaluation service member of ICC-ES.

B. Hanger-Rod Stiffeners: Install hanger-rod stiffeners as per delegated design where indicated or scheduled on Drawings to receive them and where required to prevent buckling of hanger rods caused by seismic forces.

C. Strength of Support and Seismic-Restraint Assemblies: Where not indicated, select sizes of components so strength will be adequate to carry present and future static and seismic loads within specified loading limits.

3.3 SEISMIC-RESTRAINT DEVICE INSTALLATION

A. Coordinate the location of embedded connection hardware with supported equipment attachment and mounting points and with requirements for concrete reinforcement and formwork specified in Section 033000 "Cast-in-Place Concrete."

B. Equipment and Hanger Restraints:

1. Install resilient, bolt-isolation washers on equipment anchor bolts where clearance between anchor and adjacent surface exceeds 0.125 inch (3.2 mm).

2. Install seismic-restraint devices using methods approved by an evaluation service member of ICC-ES providing required submittals for component.

C. Install cables so they do not bend across edges of adjacent equipment or building structure.

D. 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.

E. Attachment to Structure: If specific attachment is not indicated, anchor bracing to structure at flanges of beams, at upper truss chords of bar joists, or at concrete members.

F. Drilled-in Anchors:

1. Identify position of reinforcing steel and other embedded items prior to drilling holes for anchors. Do not damage existing reinforcing or embedded items during coring or drilling. Notify the structural engineer if reinforcing steel or other embedded items are

encountered during drilling. Locate and avoid prestressed tendons, electrical and telecommunications conduit, and gas lines.

2. Do not drill holes in concrete or masonry until concrete, mortar, or grout has achieved full design strength.

3. Wedge Anchors: Protect threads from damage during anchor installation. Heavy-duty sleeve anchors shall be installed with sleeve fully engaged in the structural element to which anchor is to be fastened.

4. Adhesive Anchors: Clean holes to remove loose material and drilling dust prior to installation of adhesive. Place adhesive in holes proceeding from the bottom of the hole and progressing toward the surface in such a manner as to avoid introduction of air pockets in the adhesive.

5. Set anchors to manufacturer's recommended torque using a torque wrench.

6. Install zinc-coated steel anchors for interior and stainless-steel anchors for exterior applications.

3.4 ACCOMMODATION OF DIFFERENTIAL SEISMIC MOTION

A. Install flexible connections in runs of raceways, cables, wireways, cable trays, and busways where they cross seismic joints, where adjacent sections or branches are supported by different structural elements, and where connection is terminated to equipment that is anchored to a different structural element from the one supporting them as they approach equipment.

3.5 FIELD QUALITY CONTROL

A. Testing Agency: Owner will engage a qualified testing agency to perform tests and inspections.

B. Perform the following tests and inspections with the assistance of a factory-authorized service representative:

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.

C. Seismic controls will be considered defective if they do not pass tests and inspections.

D. Prepare test and inspection reports.

3.6 ADJUSTING

A. Adjust restraints to permit free movement of equipment within normal mode of operation.

END OF SECTION 26 0548.16

SECTION 26 0553 - IDENTIFICATION FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Color and legend requirements for raceways, conductors, and warning labels and signs.
2. Labels.
3. Bands and tubes.
4. Tapes and stencils.
5. Tags.
6. Signs.
7. Cable ties.
8. Paint for identification.
9. Fasteners for labels and signs.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for electrical identification products.

B. Samples: For each type of label and sign to illustrate composition, size, colors, lettering style, mounting provisions, and graphic features of identification products.

C. Identification Schedule: For each piece of electrical equipment and electrical system components to be an index of nomenclature for electrical equipment and system components used in identification signs and labels. Use same designations indicated on Drawings.

D. Delegated-Design Submittal: For arc-flash hazard study.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Comply with ASME A13.1 and IEEE C2.

B. Comply with NFPA 70.

C. Comply with 29 CFR 1910.144 and 29 CFR 1910.145.

D. Comply with ANSI Z535.4 for safety signs and labels.

E. Comply with NFPA 70E requirements for arc-flash warning labels.

F. Adhesive-attached labeling materials, including label stocks, laminating adhesives, and inks used by label printers, shall comply with UL 969.

G. Thermal Movements: Allow for thermal movements from ambient and surface temperature changes.

1. Temperature Change: 120 deg F (67 deg C), ambient; 180 deg F (100 deg C), material surfaces.

2.2 COLOR AND LEGEND REQUIREMENTS

A. Raceways and Cables Carrying Circuits at 600 V or Less:

1. Black letters on an orange field.

2. Legend: Indicate voltage and system or service type.

B. Color-Coding for Phase- and Voltage-Level Identification, 600 V or Less: Use colors listed below for ungrounded service feeder and branch-circuit conductors.

1. Color shall be factory applied or field applied for sizes larger than No. 8 AWG

2. Colors for 208/120-V Circuits:

a. Phase A: Black.

b. Phase B: Red.

c. Phase C: Blue.

3. Colors for 240-V Circuits:

a. Phase A: Black.

b. Phase B: Red.

4. Colors for 480/277-V Circuits:

a. Phase A: Brown.

b. Phase B: Orange.

c. Phase C: Yellow.

5. Color for Neutral: White for 208V or gray for 480V.

6. Color for Equipment Grounds: Green.

7. Colors for Isolated Grounds: Green with two or more yellow stripes.

C. Raceways and Cables Carrying Circuits at More Than 600 V:

1. Black letters on an orange field.

2. Legend: "DANGER - CONCEALED HIGH VOLTAGE WIRING." Warning Label Colors:

3. Identify system voltage with black letters on an orange background.

D. Warning labels and signs shall include, but are not limited to, the following legends:

1. Multiple Power Source Warning: "DANGER - ELECTRICAL SHOCK HAZARD - EQUIPMENT HAS MULTIPLE POWER SOURCES."

2. Workspace Clearance Warning: "WARNING - OSHA REGULATION - AREA IN FRONT OF ELECTRICAL EQUIPMENT MUST BE KEPT CLEAR FOR 36 INCHES (915 MM)."

E. Equipment Identification Labels:

1. Black letters on a white field.

2.3 LABELS

A. Vinyl Wraparound Labels: Preprinted, flexible labels laminated with a clear, weather- and chemical-resistant coating and matching wraparound clear adhesive tape for securing label ends.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Brady Corporation.

b. Champion America.

c. emedco.

d. Grafoplast Wire Markers.

e. HellermannTyton.

f. LEM Products Inc.

g. Marking Services, Inc.

h. Panduit Corp.

i. Seton Identification Products; a Brady Corporation company.

B. Snap-around Labels: Slit, pretensioned, flexible, preprinted, color-coded acrylic sleeves, with diameters sized to suit diameters and that stay in place by gripping action.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Brady Corporation.

b. HellermannTyton.

c. Marking Services, Inc.

d. Panduit Corp.

e. Seton Identification Products; a Brady Corporation company.

C. Self-Adhesive Wraparound Labels: Preprinted, 3-mil- (0.08-mm-) thick, vinyl flexible label with acrylic pressure-sensitive adhesive.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Brady Corporation.

b. Brother International Corporation.

c. emedco.

d. Ideal Industries, Inc.

e. Panduit Corp.

f. Seton Identification Products; a Brady Corporation company.

2. Self-Lamination: Clear; UV-, weather- and chemical-resistant; self-laminating, protective shield over the legend. Labels sized such that the clear shield overlaps the entire printed legend.

3. Marker for Labels: Permanent, waterproof, black ink marker recommended by tag manufacturer.

4. Marker for Labels: Machine-printed, permanent, waterproof, black ink recommended by printer manufacturer.

D. Self-Adhesive Labels: Vinyl, thermal, transfer-printed, 3-mil- (0.08-mm-) thick, multicolor, weather- and UV-resistant, pressure-sensitive adhesive labels, configured for intended use and location.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Brady Corporation.

b. Brother International Corporation.

c. emedco.

d. Grafoplast Wire Markers.

e. Ideal Industries, Inc.

f. Panduit Corp.

g. Seton Identification Products; a Brady Corporation company.

2. Minimum Nominal Size:

a. 1-1/2 by 6 inches (37 by 150 mm) for raceway and conductors.

b. 3-1/2 by 5 inches (76 by 127 mm) for equipment.

c. As required by authorities having jurisdiction.

2.4 BANDS AND TUBES

A. Snap-around, Color-Coding Bands: Slit, pretensioned, flexible, solid-colored acrylic sleeves, 2 inches (50 mm) long, with diameters sized to suit diameters and that stay in place by gripping action.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Brady Corporation.

b. HellermannTyton.

c. Panduit Corp.

B. Heat-Shrink Preprinted Tubes: Flame-retardant polyolefin tubes with machine-printed identification labels, sized to suit diameter and shrunk to fit firmly. Full shrink recovery occurs at a maximum of 200 deg F (93 deg C). Comply with UL 224.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Brady Corporation.

b. Panduit Corp.

2.5 TAPES AND STENCILS

A. Marker Tapes: Vinyl or vinyl-cloth, self-adhesive wraparound type, with circuit identification legend machine printed by thermal transfer or equivalent process.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Carlton Industries, LP.

b. Champion America.

c. Ideal Industries, Inc.

d. Panduit Corp.

B. Self-Adhesive Vinyl Tape: Colored, heavy duty, waterproof, fade resistant; not less than 3 mils (0.08 mm) thick by 1 to 2 inches (25 to 50 mm) wide; compounded for outdoor use.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Brady Corporation.

b. Carlton Industries, LP.

c. emedco.

d. Marking Services, Inc.

C. Tape and Stencil: 4-inch- (100-mm-) wide black stripes on 10-inch (250-mm) centers placed diagonally over orange background and are 12 inches (300 mm) wide. Stop stripes at legends.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Brimar Industries, Inc.

b. HellermannTyton.

c. LEM Products Inc.

d. Marking Services, Inc.

e. Seton Identification Products; a Brady Corporation company.

D. Floor Marking shall be accomplished by utilizing yellow floor paint to mark clearances required. See architecural floor paint section Division 099123.

E. Underground-Line Warning Tape:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Brady Corporation.

b. Brimar Industries, Inc.

c. Ideal Industries, Inc.

d. LEM Products Inc.

e. Marking Services, Inc.

f. Reef Industries, Inc.

g. Seton Identification Products; a Brady Corporation company.

2. Tape:

a. Recommended by manufacturer for the method of installation and suitable to identify and locate underground (BP-1) utility lines.

b. Printing on tape shall be permanent and shall not be damaged by burial operations.

c. Tape material and ink shall be chemically inert and not subject to degradation when exposed to acids, alkalis, and other destructive substances commonly found in soils.

d. Shall be foil-backed so as to be traceable/detectable. Stub into pull boxes, gear, etc. as practicable for tracer connection.

3. Color and Printing:

a. Comply with ANSI Z535.1, ANSI Z535.2, ANSI Z535.3, ANSI Z535.4, and ANSI Z535.5.

b. Inscriptions for Red-Colored Tapes: "ELECTRIC LINE, HIGH VOLTAGE".

c. Inscriptions for Orange-Colored Tapes: "TELEPHONE CABLE, CATV CABLE, COMMUNICATIONS CABLE, OPTICAL FIBER CABLE".

4. Trench Marking:

a. Reinforced, detectable three-layer laminate, consisting of a printed pigmented woven scrim, a solid aluminum-foil core, and a clear protective film that allows inspection of the continuity of the conductive core; bright-colored, continuous-printed on one side, compounded for direct-burial service.

b. Width: 3 inches (75 mm).

c. Overall Thickness: 8 mils (0.2 mm).

d. Foil Core Thickness: 0.35 mil (0.00889 mm).

e. Weight: 34 lb/1000 sq. ft. (16.6 kg/100 sq. m).

f. Tensile according to ASTM D882: 300 lbf (1334 N) and 12,500 psi (86.1 MPa).

F. Stenciled Legend: In nonfading, waterproof, black ink or paint. Minimum letter height shall be 1 inch (25 mm).

2.6 TAGS

A. Metal Tags: Brass or aluminum, 2 by 2 by 0.05 inch (50 by 50 by 1.3 mm), with stamped legend, punched for use with self-locking cable tie fastener.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Brady Corporation.

b. Carlton Industries, LP.

c. Emedco.

d. Marking Services, Inc.

e. Seton Identification Products; a Brady Corporation company.

B. Nonmetallic Preprinted Tags: Polyethylene tags, 0.023 inch (0.58 mm) thick, color-coded for phase and voltage level, with factory printed permanent designations; punched for use with self-locking cable tie fastener.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Brady Corporation.

b. Carlton Industries, LP.

c. Emedco.

d. Grafoplast Wire Markers.

e. LEM Products Inc.

f. Marking Services, Inc.

g. Panduit Corp.

h. Seton Identification Products; a Brady Corporation company.

C. Write-on Tags:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Brimar Industries, Inc.

b. Carlton Industries, LP.

c. LEM Products Inc.

d. Seton Identification Products; a Brady Corporation company.

2. Polyester Tags: 0.015 inch (0.38 mm) thick, with corrosion-resistant grommet and cable tie for attachment.

3. Marker for Tags: Permanent, waterproof, black ink marker recommended by tag manufacturer.

4. Marker for Tags: Machine-printed, permanent, waterproof, black ink marker recommended by printer manufacturer.

2.7 SIGNS

A. Baked-Enamel Signs:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    a. Carlton Industries, LP.
    b. Champion America.
    c. Emedco.
    d. Marking Services, Inc.
2. Preprinted aluminum signs, punched or drilled for fasteners, with colors, legend, and size required for application.
3. 1/4-inch (6.4-mm) grommets in corners for mounting.
4. Nominal Size: 7 by 10 inches (180 by 250 mm).

B. Metal-Backed Butyrate Signs:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    a. Brady Corporation.
    b. Champion America.
    c. emedco.
    d. Marking Services, Inc.
2. Weather-resistant, nonfading, preprinted, cellulose-acetate butyrate signs, with 0.0396-inch (1-mm) galvanized-steel backing, punched and drilled for fasteners, and with colors, legend, and size required for application.
3. 1/4-inch (6.4-mm) grommets in corners for mounting.
4. Nominal Size: 10 by 14 inches (250 by 360 mm).

C. Laminated Acrylic or Melamine Plastic Signs:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    a. Brady Corporation.
    b. Carlton Industries, LP.
    c. Emedco.
    d. Marking Services, Inc.
2. Engraved legend.
3. Thickness:

a. For signs up to 20 sq. in. (129 sq. cm), minimum 1/16 inch (1.6 mm) thick.

b. For signs larger than 20 sq. in. (129 sq. cm), 1/8 inch (3.2 mm) thick.

c. Engraved legend with black letters on white face.

d. Punched or drilled for mechanical fasteners with 1/4-inch (6.4-mm) grommets in corners for mounting.

e. Framed with mitered acrylic molding and arranged for attachment at applicable equipment.

2.8 CABLE TIES

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. HellermannTyton.

2. Ideal Industries, Inc.

3. Marking Services, Inc.

4. Panduit Corp.

B. General-Purpose Cable Ties: Fungus inert, self-extinguishing, one piece, self-locking, and Type 6/6 nylon.

1. Minimum Width: 3/16 inch (5 mm).

2. Tensile Strength at 73 Deg F (23 Deg C) according to ASTM D638: 12,000 psi (82.7 MPa).

3. Temperature Range: Minus 40 to plus 185 deg F (Minus 40 to plus 85 deg C).

4. Color: Black, except where used for color-coding.

C. UV-Stabilized Cable Ties: Fungus inert, designed for continuous exposure to exterior sunlight, self-extinguishing, one piece, self-locking, and Type 6/6 nylon.

1. Minimum Width: 3/16 inch (5 mm).

2. Tensile Strength at 73 Deg F (23 Deg C) according to ASTM D638: 12,000 psi (82.7 MPa).

3. Temperature Range: Minus 40 to plus 185 deg F (Minus 40 to plus 85 deg C).

4. Color: Black.

D. Plenum-Rated Cable Ties: Self-extinguishing, UV stabilized, one piece, and self-locking.

1. Minimum Width: 3/16 inch (5 mm).

2. Tensile Strength at 73 Deg F (23 Deg C) according to ASTM D638: 7000 psi (48.2 MPa).

3. UL 94 Flame Rating: 94V-0.

4. Temperature Range: Minus 50 to plus 284 deg F (Minus 46 to plus 140 deg C).

5. Color: Black.

2.9 MISCELLANEOUS IDENTIFICATION PRODUCTS

A. Paint: Comply with requirements in painting Sections for paint materials and application requirements. Retain paint system applicable for surface material and location (exterior or interior).

B. Fasteners for Labels and Signs: Self-tapping, stainless-steel screws or stainless-steel machine screws with nuts and flat and lock washers.

PART 3 - EXECUTION

3.1 PREPARATION

A. Self-Adhesive Identification Products: Before applying electrical identification products, clean substrates of substances that could impair bond, using materials and methods recommended by manufacturer of identification product.

3.2 INSTALLATION

A. Verify and coordinate identification names, abbreviations, colors, and other features with requirements in other Sections requiring identification applications, Drawings, Shop Drawings, manufacturer's wiring diagrams, and operation and maintenance manual. Use consistent designations throughout Project.

B. Install identifying devices before installing acoustical ceilings and similar concealment.

C. Verify identity of each item before installing identification products.

D. Coordinate identification with Project Drawings, manufacturer's wiring diagrams, and operation and maintenance manual.

E. Apply identification devices to surfaces that require finish after completing finish work.

F. Install signs with approved legend to facilitate proper identification, operation, and maintenance of electrical systems and connected items.

G. System Identification for Raceways and Cables under 600 V: Identification shall completely encircle cable or conduit. Place identification of two-color markings in contact, side by side.

1. Secure tight to surface of conductor, cable, or raceway.

H. System Identification for Raceways and Cables over 600 V: Identification shall completely encircle cable or conduit. Place adjacent identification of two-color markings in contact, side by side.

1. Secure tight to surface of conductor, cable, or raceway.

I. Auxiliary Electrical Systems Conductor Identification: Identify field-installed alarm, control, and signal connections.

J. Emergency Operating Instruction Signs: Install instruction signs with white legend on a red background with minimum 3/8-inch- (10-mm-) high letters for emergency instructions at equipment used for power transfer load shedding.

K. Elevated Components: Increase sizes of labels, signs, and letters to those appropriate for viewing from the floor.

L. Accessible Fittings for Raceways: Identify the covers of each junction and pull box of the following systems with the wiring system legend and system voltage. System legends shall be as follows:

1. "EMERGENCY POWER."

2. "POWER."

3. "UPS."

4. The panel and circuit number from which the circuit is fed shall be included in each label for each surface mounted conduit at 50’ on center and at the termination points of underground or concealed conduits. Conduits shall be labeled at identifiable points at 50’ on center, whichever comes first.

M. Vinyl Wraparound Labels:

1. Secure tight to surface of raceway or cable at a location with high visibility and accessibility.

2. Attach labels that are not self-adhesive type with clear vinyl tape, with adhesive appropriate to the location and substrate.

N. Snap-around Labels: Secure tight to surface at a location with high visibility and accessibility.

O. Self-Adhesive Wraparound Labels: Secure tight to surface at a location with high visibility and accessibility.

P. Self-Adhesive Labels:

1. On each item, install unique designation label that is consistent with wiring diagrams, schedules, and operation and maintenance manual.

2. Unless otherwise indicated, provide a single line of text with 1/2-inch- (13-mm-) high letters on 1-1/2-inch- (38-mm-) high label; where two lines of text are required, use labels 2 inches (50 mm) high.

Q. Snap-around Color-Coding Bands: Secure tight to surface at a location with high visibility and accessibility.

R. Heat-Shrink, Preprinted Tubes: Secure tight to surface at a location with high visibility and accessibility.

S. Marker Tapes: Secure tight to surface at a location with high visibility and accessibility.

T. Self-Adhesive Vinyl Tape: Secure tight to surface at a location with high visibility and accessibility.

1. Field-Applied, Color-Coding Conductor Tape: Apply in half-lapped turns for a minimum distance of 6 inches (150 mm) where splices or taps are made. Apply last two turns of tape with no tension to prevent possible unwinding.

U. Tape and Stencil: Comply with requirements in painting Sections for surface preparation and paint application.

V. Floor Marking Tape: Apply stripes to finished surfaces following manufacturer's written instructions.

W. Underground Line Warning Tape:

1. During backfilling of trenches, install continuous underground-line warning tape directly above cable or raceway at 6 to 8 inches (150 to 200 mm) below finished grade. Use multiple tapes where width of multiple lines installed in a common trench or concrete envelope exceeds 16 inches (400 mm) overall.

2. Limit use of underground-line warning tape to direct-buried cables.

3. Install underground-line warning tape for direct-buried cables and cables in raceways.

X. Metal Tags:

1. Place in a location with high visibility and accessibility.

2. Secure using UV-stabilized cable ties.

Y. Nonmetallic Preprinted Tags:

1. Place in a location with high visibility and accessibility.

2. Secure using UV-stabilized cable ties.

Z. Write-on Tags:

1. Place in a location with high visibility and accessibility.

2. Secure using UV-stabilized cable ties.

AA. Baked-Enamel Signs:

1. Attach signs that are not self-adhesive type with mechanical fasteners appropriate to the location and substrate.

2. Unless otherwise indicated, provide a single line of text with 1/2-inch- (13-mm-) high letters on minimum 1-1/2-inch- (38-mm-) high sign; where two lines of text are required, use signs minimum 2 inches (50 mm) high.

BB. Metal-Backed Butyrate Signs:

1. Attach signs that are not self-adhesive type with mechanical fasteners appropriate to the location and substrate.

2. Unless otherwise indicated, provide a single line of text with 1/2-inch- (13-mm-) high letters on 1-1/2-inch- (38-mm-) high sign; where two lines of text are required, use labels 2 inches (50 mm) high.

CC. Laminated Acrylic or Melamine Plastic Signs:

1. Attach signs that are not self-adhesive type with mechanical fasteners appropriate to the location and substrate.

2. Unless otherwise indicated, provide a single line of text with 1/2-inch- (13-mm-) high letters on 1-1/2-inch- (38-mm-) high sign; where two lines of text are required, use labels 2 inches (50 mm) high.

DD. Cable Ties: General purpose, for attaching tags, except as listed below:

1. Outdoors: UV-stabilized nylon.

2. In Spaces Handling Environmental Air: Plenum rated.

3.3 IDENTIFICATION SCHEDULE

A. Install identification materials and devices at locations for most convenient viewing without interference with operation and maintenance of equipment. Install access doors or panels to provide view of identifying devices.

B. Identify conductors, cables, and terminals in enclosures and at junctions, terminals, pull points, and locations of high visibility. Identify by system and circuit designation.

C. Concealed Raceways, Duct Banks, More Than 600 V, within Buildings: Tape and stencil. Stencil legend "DANGER - CONCEALED HIGH-VOLTAGE WIRING" with 3-inch- (75-mm-) high, black letters on 20-inch (500-mm) centers.

1. Locate identification at changes in direction, at penetrations of walls and floors, and at 10-foot (3-m) maximum intervals.

D. Accessible Raceways Armored and Metal-Clad Cables, More Than 600 V: Vinyl wraparound labels.

1. Locate identification at changes in direction, at penetrations of walls and floors, at 50-foot (15-m) maximum intervals in straight runs, and at 25-foot (7.6-m) maximum intervals in congested areas.

E. Accessible Raceways and Metal-Clad Cables, 600 V or Less, for Service, Feeder, and Branch Circuits, More Than 30 A and 120 V to Ground: Identify with self-adhesive raceway labels.

1. Locate identification at changes in direction, at penetrations of walls and floors, at 50-foot (15-m) maximum intervals in straight runs, and at 25-foot (7.6-m) maximum intervals in congested areas.

F. Accessible Fittings for Raceways and Cables within Buildings: Identify the covers of each junction and pull box of the following systems with self-adhesive labels containing the wiring system legend and system voltage. System legends shall be as follows:

1. "EMERGENCY POWER."

2. "POWER."

3. "UPS."

G. Power-Circuit Conductor Identification, 600 V or Less: For conductors in vaults, pull and junction boxes, manholes, and handholes, use vinyl wraparound labels to identify the phase.

1. Locate identification at changes in direction, at penetrations of walls and floors, at 50-foot (15-m) maximum intervals in straight runs, and at 25-foot (7.6-m) maximum intervals in congested areas.

H. Power-Circuit Conductor Identification, More Than 600 V: For conductors in vaults, pull and junction boxes, manholes, and handholes, use nonmetallic preprinted tags colored and marked to indicate phase, and a separate tag with the circuit designation.

I. Control-Circuit Conductor Identification: For conductors and cables in pull and junction boxes, manholes, and handholes, use self-adhesive labels with the conductor or cable designation, origin, and destination.

J. Control-Circuit Conductor Termination Identification: For identification at terminations, provide self-adhesive labels with the conductor designation.

K. Conductors to Be Extended in the Future: Attach marker tape to conductors.

L. Auxiliary Electrical Systems Conductor Identification: Self-adhesive vinyl tape that is uniform and consistent with system used by manufacturer for factory-installed connections.

1. Identify conductors, cables, and terminals in enclosures and at junctions, terminals, and pull points. Identify by system and circuit designation.

M. Locations of Underground Lines: Underground-line warning tape for power, lighting, communication, and control wiring and optical-fiber cable.

N. Concealed Raceways and Duct Banks, More Than 600 V, within Buildings: Apply floor marking tape to the following finished surfaces:

1. Floor surface directly above conduits running beneath and within 12 inches (300 mm) of a floor that is in contact with earth or is framed above unexcavated space.

2. Wall surfaces directly external to raceways concealed within wall.

3. Accessible surfaces of concrete envelope around raceways in vertical shafts, exposed in the building, or concealed above suspended ceilings.

O. Workspace Indication: Apply floor marking tape to finished surfaces. Show working clearances in the direction of access to live parts. Workspace shall comply with NFPA 70 and

29 CFR 1926.403 unless otherwise indicated. Do not install at flush-mounted panelboards and similar equipment in finished spaces.

P. Instructional Signs: Self-adhesive labels, including the color code for grounded and ungrounded conductors.

Q. Warning Labels for Indoor Cabinets, Boxes, and Enclosures for Power and Lighting: Self-adhesive labels.

1. Apply to exterior of door, cover, or other access.

2. For equipment with multiple power or control sources, apply to door or cover of equipment, including, but not limited to, the following:

a. Power-transfer switches.

b. Controls with external control power connections.

R. Arc Flash Warning Labeling: Self-adhesive labels.

S. Operating Instruction Signs: Self-adhesive labels.

T. Emergency Operating Instruction Signs: Self-adhesive labels with white legend on a red background with minimum 3/8-inch- (10-mm-) high letters for emergency instructions at equipment used for power transfer or load shedding.

U. Equipment Identification Labels:

1. Indoor Equipment: Self-adhesive label.

2. Outdoor Equipment: Laminated acrylic or melamine sign.

3. Equipment to Be Labeled:

a. Panelboards: Typewritten directory of circuits in the location provided by panelboard manufacturer. Panelboard identification shall be in the form of a self-adhesive, engraved, laminated acrylic or melamine label.

b. Enclosures and electrical cabinets.

c. Access doors and panels for concealed electrical items.

d. Emergency system boxes and enclosures.

e. Enclosed switches.

f. Enclosed circuit breakers.

g. Push-button stations.

h. Contactors.

i. Remote-controlled switches, dimmer modules, and control devices.

j. Battery-inverter units.

k. Battery racks.

l. UPS equipment.

END OF SECTION 26 0553

SECTION 260924 - LIGHTING CONTROL DEVICES

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. Time switches.
2. Photoelectric switches.
3. Standalone daylight-harvesting switching and dimming controls.
4. Switchbox-mounted occupancy sensors.
5. Digital timer light switches.
6. Extreme temperature occupancy sensors.
7. Outdoor motion sensors.
8. Lighting contactors.
9. Emergency shunt relays.

B. Related Requirements:

1. Section 262726 "Wiring Devices" for wall-box dimmers, non-networkable wall-switch occupancy sensors, and manual light switches.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Shop Drawings:

1. Show installation details for all devices.
2. Interconnection diagrams showing field-installed wiring.
3. Include diagrams for power, signal, and control wiring.

1.4 INFORMATIONAL SUBMITTALS

A. Coordination Drawings: Reflected ceiling plan(s) and elevations, drawn to scale, on which the following items are shown and coordinated with each other, using input from installers of the items involved:

1. Suspended ceiling components.

2. Structural members to which equipment will be attached.

3. Items penetrating finished ceiling, including the following:

a. Luminaires.

b. Air outlets and inlets.

c. Speakers.

d. Sprinklers.

e. Access panels.

f. Control modules.

B. Field quality-control reports.

C. Sample Warranty: For manufacturer's warranties.

1.5 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For each type of lighting control device to include in operation and maintenance manuals.

B. Software and Firmware Operational Documentation:

1. Software operating and upgrade manuals.

2. Program Software Backup: On USB media. Provide names, versions, and website addresses for locations of installed software.

3. Device address list.

4. Printout of software application and graphic screens.

1.6 WARRANTY

A. Manufacturer's Warranty: Manufacturer and Installer agree to repair or replace lighting control devices that fail(s) in materials or workmanship within specified warranty period.

1. Failures include, but are not limited to, the following:

a. Faulty operation of lighting control software.

b. Faulty operation of lighting control devices.

2. Warranty Period: Two year(s) from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 ELECTRONIC TIME SWITCHES

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Cooper Industries, Inc.
2. Intermatic, Inc.
3. Invensys Controls.
4. Leviton Manufacturing Co., Inc.
5. NSi Industries LLC.
6. TE Connectivity Ltd.

B. Electronic Time Switches: Solid state, programmable, with alphanumeric display; complying with UL 917.

1. Listed and labeled as defined in NFPA 70 and marked for intended location and application.
2. Contact Configuration: SPST.
3. Contact Rating: 30-A inductive or resistive, 240-V ac.
4. Programs: Eight on-off set points on a 24-hour schedule and an annual holiday schedule that overrides the weekly operation on holidays.
5. Programs: Two on-off set points on a 24-hour schedule, allowing different set points for each day of the week and an annual holiday schedule that overrides the weekly operation on holidays.
6. Programs: 4 channels; each channel is individually programmable with 40 on-off operations per week and an annual holiday schedule that overrides the weekly operation on holidays.
7. Circuitry: Allow connection of a photoelectric relay as substitute for on-off function of a program on selected channels.
8. Astronomic Time: All channels.
9. Automatic daylight savings time changeover.
10. Battery Backup: Not less than seven days reserve, to maintain schedules and time clock.

2.2 ELECTROMECHANICAL DIAL-TIME SWITCHES

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Cooper Industries, Inc.
2. Intermatic, Inc.
3. Invensys Controls.
4. Leviton Manufacturing Co., Inc.

5. NSi Industries LLC.

6. TE Connectivity Ltd.

B. Electromechanical-Dial Time Switches: Comply with UL 917.

1. Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

2. Contact Configuration: SPST.

3. Contact Rating: 30-A inductive or resistive, 240-V ac 20-A ballast load, 120-/240-V ac.

4. Circuitry: Allows connection of a photoelectric relay as a substitute for the on-off function of a program.

5. Astronomic time dial.

6. Eight-Day Program: Uniquely programmable for each weekday and holidays.

7. Skip-a-day mode.

8. Wound-spring reserve carryover mechanism to keep time during power failures, minimum of 16 hours.

2.3 OUTDOOR PHOTOELECTRIC SWITCHES, SOLID STATE, FLEXIBLE MOUNTING

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Cooper Industries, Inc.

2. Intermatic, Inc.

3. Leviton Manufacturing Co., Inc.

4. NSi Industries LLC.

5. TE Connectivity Ltd.

B. Description: Solid state, with SPST dry contacts rated for 1000 W incandescent or 1800 VA inductive, to operate connected relay, contactor coils, or microprocessor input; complying with UL 773A, and compatible with ballasts and LED lamps.

1. Listed and labeled as defined in NFPA 70, by a agency NRTL, and marked for intended location and application.

2. Light-Level Monitoring Range: 1.5 to 10 fc (16.14 to 108 lux), with an adjustment for turn-on and turn-off levels within that range, and a directional lens in front of the photocell to prevent fixed light sources from causing turn-off.

3. Time Delay: Fifteen-second minimum, to prevent false operation.

4. Surge Protection: Metal-oxide varistor.

5. Mounting: Twist lock complies with ANSI C136.10, with base-and-stem mounting or stem-and-swivel mounting accessories as required to direct sensor to the north sky exposure from same source and manufacturer as switch.

6. Failure Mode: Luminaire stays ON.

2.4 OUTDOOR PHOTOELECTRIC SWITCHES, SOLID STATE, LUMINAIRE-MOUNTED

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Cooper Industries, Inc.

2. Intermatic, Inc.

3. Leviton Manufacturing Co., Inc.

4. NSi Industries LLC.

5. TE Connectivity Ltd.

B. Description: Solid state, with SPST dry contacts rated for 1000 W incandescent, to operate connected load, complying with UL 773, and compatible with CFL and LED lamps.

1. Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

2. Light-Level Monitoring Range: 1.5 to 10 fc (16.14 to 108 lux), with an adjustment for turn-on and turn-off levels within that range.

3. Time Delay: Thirty-second minimum, to prevent false operation.

4. Lightning Arrester: Air-gap type.

5. Mounting: Twist lock complying with ANSI C136.10, with base.

6. Failure Mode: Luminaire stays ON.

2.5 OUTDOOR PHOTOELECTRIC SWITCHES, LOW VOLTAGE

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Cooper Industries, Inc.

2. Intermatic, Inc.

3. Leviton Manufacturing Co., Inc.

4. NSi Industries LLC.

5. TE Connectivity Ltd.

B. Description: Solid state; one set of NO dry contacts rated to operate connected load, complying with UL 773, and compatible with luminaire power pack and lighting control panelboard.

1. Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

2. Light-Level Monitoring Range: 1.5 to 10 fc (16.14 to 108 lux), with an adjustment for turn-on and turn-off levels within that range.

3. Time Delay: Thirty-second minimum, to prevent false operation.

4. Mounting: 1/2-inch (13-mm) threaded male conduit.

5. Failure Mode: Luminaire stays ON.

6. Power Pack: Dry contacts rated for 20-A ballast or LED load at 120- and 277-V ac, for 13-A tungsten at 120-V ac, and for 1 hp at 120-V ac. Sensor has 24-V dc, 150-mA, Class 2 power source, as defined by NFPA 70.

a. LED status lights to indicate load status.

b. Plenum rated.

7. Power Pack: Digital controller capable of accepting a minimum of three RJ45 inputs with two outputs rated for 20-A incandescent or LED load at 120- and 277-V ac, for 16-A ballast or LED at 120- and 277-V ac, and for 1 hp at 120-V ac. Sensor has 24-V dc, Class 2 power source, as defined by NFPA 70.

a. With integral current monitoring.

b. Compatible with digital addressable lighting interface.

c. Plenum rated.

2.6 DAYLIGHT-HARVESTING SWITCHING CONTROLS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Cooper Industries, Inc.

2. Eaton.

3. Hubbell Building Automation, Inc.

4. Leviton Manufacturing Co., Inc.

5. Lithonia Lighting; Acuity Brands Lighting, Inc.

6. NSi Industries LLC.

7. Sensor Switch, Inc.

8. TE Connectivity Ltd.

9. WattStopper; a Legrand® Group brand.

B. Description: System operates indoor lighting.

C. Sequence of Operation: As daylight increases, the lights are turned off at a predetermined level. As daylight decreases, the lights are turned on at a predetermined level.

1. Lighting control set point is based on two lighting conditions:

a. When no daylight is present.

b. When significant daylight is present (target level).

c. System programming is done with two hand-held, remote-control tools.

D. Ceiling-Mounted Switching Controls: Solid-state, light-level sensor unit, with integrated power pack, that detects changes in indoor lighting levels that are perceived by the eye.

E. Ceiling-Mounted Switching Controls: Solid-state, light-level sensor unit, with separate power pack mounted on luminaire, that detects changes in indoor lighting levels that are perceived by the eye.

F. Electrical Components, Devices, and Accessories:

1. Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

2. Operating Ambient Conditions: Dry interior conditions, 32 to 120 deg F (0 to 49 deg C).

3. Sensor Output: Contacts rated to operate the associated power pack, complying with UL 773A. Sensor shall be powered by the power pack.

4. Sensor Output: Digital signal compatible with power pack.

5. Power Pack: Dry contacts rated for 20-A ballast or LED load at 120- and 277-V ac, for 13-A tungsten at 120-V ac, and for 1 hp at 120-V ac. Sensor has 24-V dc, 150-mA, Class 2 power source, as defined by NFPA 70.

a. LED status lights to indicate load status.

b. Plenum rated.

6. Power Pack: Digital controller capable of accepting 3 RJ45 inputs with two outputs rated for 20-A incandescentor LED load at 120- and 277-V ac, for 16-A ballast or LEDat 120- and 277-V ac, and for 1 hp at 120-V ac. Sensor has 24-V dc Class 2 power source, as defined by NFPA 70.

a. With integral current monitoring

b. Compatible with digital addressable lighting interface.

c. Plenum rated.

7. General Space Sensors Light-Level Monitoring Range: 10 to 200 fc (108 to 2152 lux), with an adjustment for turn-on and turn-off levels within that range.

8. Atrium Space Sensors Light-Level Monitoring Range: 100 to 1000 fc (1080 to 10 800 lux), with an adjustment for turn-on and turn-off levels within that range.

9. Skylight Sensors Light-Level Monitoring Range: 1000 to 10,000 fc (10 800 to 108 000 lux), with an adjustment for turn-on and turn-off levels within that range.

10. Time Delay: Adjustable from 5 to 300 seconds to prevent cycling.

11. Set-Point Adjustment: Equip with deadband adjustment of 25, 50, and 75 percent above the "on" set point, or provide with separate adjustable "on" and "off" set points.

12. Test Mode: User selectable, overriding programmed time delay to allow settings check.

13. Control Load Status: User selectable to confirm that load wiring is correct.

14. Indicator: Two digital displays to indicate the beginning of on-off cycles.

2.7 DAYLIGHT-HARVESTING DIMMING CONTROLS, ANALOG

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Cooper Industries, Inc.

2. Hubbell Building Automation, Inc.

3. Leviton Manufacturing Co., Inc.

4. Lithonia Lighting; Acuity Brands Lighting, Inc.

5. WattStopper; a Legrand® Group brand.

B. Description: Sensing daylight and electrical lighting levels, the system adjusts the indoor electrical lighting levels. As daylight increases, the lights are dimmed.

1. Lighting control set point is based on two lighting conditions:

a. When no daylight is present (target level).

b. When significant daylight is present.

2. System programming is done with two hand-held, remote-control tools.

a. Initial setup tool.

b. Tool for occupants to adjust the target levels by increasing the set point up to 25 percent, or by minimizing the electric lighting level.

C. Ceiling-Mounted Dimming Controls: Solid-state, light-level sensor unit, with power pack, to detect changes in indoor lighting levels that are perceived by the eye.

D. Electrical Components, Devices, and Accessories:

1. Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

2. Sensor Output: 0- to 10-V dc to operate luminaires. Sensor is powered by controller unit.

3. Light-Level Sensor Set-Point Adjustment Range: 20 to 60 fc (120 to 640 lux).

E. Power Pack: Dry contacts rated for 20-A ballast or LED load at 120- and 277-V ac, for 13-A tungsten at 120-V ac, and for 1 hp at 120-V ac. Sensor has 24-V dc, 150-mA, Class 2 power source, as defined by NFPA 70.

1. LED status lights to indicate load status.

2. Plenum rated.

2.8 DAYLIGHT-HARVESTING DIMMING CONTROLS, DIGITAL

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Cooper Industries, Inc.

2. Hubbell Building Automation, Inc.

3. Leviton Manufacturing Co., Inc.

4. Lithonia Lighting; Acuity Brands Lighting, Inc.

5. WattStopper; a Legrand® Group brand.

B. Description: Sensing daylight and electrical lighting levels, the system adjusts the indoor electrical lighting levels. As daylight increases, lights are dimmed.

1. Lighting control set point is based on the following two lighting conditions:

a. When no daylight is present (target level).

b. When significant daylight is present.

2. System programming is done with two hand-held, remote-control tools.

a. Initial setup tool.

b. Tool for occupants to adjust the target levels by increasing the set point up to 25 percent, or by minimizing the electric lighting level.

C. Ceiling-Mounted Dimming Controls: Solid-state, light-level sensor unit, with power pack, to detect changes in indoor lighting levels that are perceived by the eye.

D. Electrical Components, Devices, and Accessories:

1. Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

2. Sensor Output: 0- to 10-V dc to operate luminaires. Sensor is powered by controller unit.

3. Light-Level Sensor Set-Point Adjustment Range: 20 to 60 fc (120 to 640 lux).

E. Power Pack: Digital controller capable of accepting three RJ45 inputs with two output(s) rated for 20-A incandescent or LED load at 120- and 277-V ac, for 16-A ballast load or LED at 120- and 277-V ac, and for 1 hp at 120-V ac. Sensor has 24-V dc Class 2 power source, as defined by NFPA 70.

1. With integral current monitoring.

2. Compatible with digital addressable lighting interface.

3. Plenum rated.

2.9 INDOOR OCCUPANCY AND VACANCY SENSORS – See Section 260923

2.10 DIGITAL TIMER LIGHT SWITCH

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Cooper Industries, Inc.

2. Intermatic, Inc.

3. Invensys Controls.

4. Leviton Manufacturing Co., Inc.

5. NSi Industries LLC.

6. TE Connectivity Ltd.

B. Description: Combination digital timer and conventional switch lighting control unit. Switchbox-mounted, backlit LCD display, with selectable time interval in 20 minute increments.

1. Rated 960 W at 120 V ac for tungsten lighting, 10 A at 120 V ac or 10 A at 277 V ac for fluorescent or LED lighting, and 1/4 hp at 120 V ac.

2. Standards: Comply with UL 20.

3. Integral relay for connection to BAS.

4. Voltage: Dual voltage - 120 and 277 V.

5. Color: Coordinate with Architect.

6. Faceplate: Color matched to switch.

2.11 EXTREME-TEMPERATURE OCCUPANCY SENSORS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Cooper Industries, Inc.

2. Sensor Switch, Inc.

B. Description: Ceiling-mounted, solid-state, extreme-temperature occupancy sensors with a separate power pack.

1. Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended application in damp locations.

2. Operation: Turn lights on when coverage area is occupied, and turn them off when unoccupied; with a time delay for turning lights off, adjustable over a minimum range of 1 to 30 minutes.

3. Operating Ambient Conditions: From minus 40 to plus 125 deg F (minus 40 to plus 52 deg C).

4. Sensor Output: Contacts rated to operate the connected relay, complying with UL 773A. Sensor is powered from the power pack.

5. Power Pack: Dry contacts rated for 20-A ballast or LED load at 120- and 277-V ac, for 13-A tungsten at 120-V ac, and for 1 hp at 120-V ac. Sensor has 24-V dc, 150-mA, Class 2 power source, as defined by NFPA 70.

6. Mounting:

a. Sensor: Suitable for mounting in any position on a standard outlet box.

b. Relay: Externally mounted through a 1/2-inch (13-mm) knockout in a standard electrical enclosure.

c. Time-Delay and Sensitivity Adjustments: Recessed and concealed behind cover.

7. Bypass Switch: Override the "on" function in case of sensor failure.

8. Automatic Light-Level Sensor: Adjustable from 2 to 10 fc (21.5 to 108 lux); keep lighting off when selected lighting level is present.

C. Detector Technology: PIR. Ceiling mounted; detect occupants in coverage area by their heat and movement.

1. Detector Sensitivity: Detect occurrences of 6-inch- (150-mm-) minimum movement of any portion of a human body that presents a target of not less than 36 sq. in. (232 sq. cm).

2. Detection Coverage (Room): Detect occupancy anywhere in a circular area of 1500 sq. ft. (139 sq. m) when mounted on a 96-inch- (2440-mm-) high ceiling.

3. Detection Coverage (High Bay): Detect occupancy within 25 feet (7.6 m) when mounted on a 25-foot- (7.6-m-) high ceiling.

2.12 OUTDOOR MOTION SENSORS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Bryant Electric.
2. Cooper Industries, Inc.
3. Hubbell Building Automation, Inc.
4. Leviton Manufacturing Co., Inc.
5. Lithonia Lighting; Acuity Brands Lighting, Inc.
6. NSi Industries LLC.
7. Sensor Switch, Inc.
8. WattStopper; a Legrand® Group brand.

B. Description: Solid-state outdoor motion sensors.

1. Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
2. Dual-technology (PIR and ultrasonic) type, weatherproof. Detect occurrences of 6-inch-(150-mm-) minimum movement of any portion of a human body that presents a target of not less than 36 sq. in. (232 sq. cm). Comply with UL 773A.
3. Switch Rating:
    a. Luminaire-Mounted Sensor: 1000-W incandescent, 500-VA fluorescent/LED.
    b. Separately Mounted Sensor: Dry contacts rated for 20-A ballast or LED load at 120- and 277-V ac, for 13-A tungsten at 120-V ac, and for 1 hp at 120-V ac. Sensor has 24-V dc, 150-mA, Class 2 power source, as defined by NFPA 70.
4. Switch Type: SP, field-selectable automatic "on," or manual "on," automatic "off."
5. Voltage: Dual voltage, 120- and 277-V type.
6. Detector Coverage:
    a. Standard Range: 210-degree field of view, with a minimum coverage area of 900 sq. ft. (84 sq. m).
    b. Long Range: 180-degree field of view and 110-foot (34-m) detection range.
7. Ambient-Light Override: Concealed, field-adjustable, light-level sensor from 10 to 150 fc (108 to 1600 lux). The switch prevents the lights from turning on when the light level is higher than the set point of the sensor.
8. Concealed, field-adjustable, "off" time-delay selector at up to 30 minutes.

9. Concealed, "off" time-delay selector at 30 seconds and 5, 10, and 20 minutes.

10. Adaptive Technology: Self-adjusting circuitry detects and memorizes usage patterns of the space and help eliminate false "off" switching.

11. Operating Ambient Conditions: Suitable for operation in ambient temperatures ranging from minus 40 to plus 130 deg F (minus 40 to plus 54 deg C), rated as "raintight" according to UL 773A.

2.13 LIGHTING CONTACTORS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Allen-Bradley/Rockwell Automation.

2. ASCO: a brand of Vertiv.

3. Eaton.

4. General Electric Company.

5. Square D.

B. Description: Electrically operated and mechanically held, combination-type lighting contactors with nonfused disconnect, complying with NEMA ICS 2 and UL 508.

1. Current Rating for Switching: Listing or rating consistent with type of load served, including tungsten filament, inductive, and high-inrush ballast (ballast with 15 percent or less THD of normal load current).

2. Fault Current Withstand Rating: Equal to or exceeding the available fault current at the point of installation.

3. Enclosure: Comply with NEMA 250.

4. Provide with control and pilot devices as indicated on Drawings and scheduled, matching the NEMA type specified for the enclosure.

C. Interface with DDC System for HVAC: Provide hardware interface to enable the DDC system for HVAC to monitor and control lighting contactors.

1. Monitoring: On-off status,.

2. Control: On-off operation,.

2.14 EMERGENCY SHUNT RELAY

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Lighting Control and Design.

2. WattStopper; a Legrand® Group brand.

B. Description: NC, electrically held relay, arranged for wiring in parallel with manual or automatic switching contacts; complying with UL 924.

1. Coil Rating: 120 V.

2.15 CONDUCTORS AND CABLES

A. Power Wiring to Supply Side of Remote-Control Power Sources: Not smaller than No. 12 AWG. Comply with requirements in Section 260519 "Low-Voltage Electrical Power Conductors and Cables."

B. Classes 2 and 3 Control Cable: Multiconductor cable with stranded-copper conductors not smaller than No. 18 AWG. Comply with requirements in Section 260519 "Low-Voltage Electrical Power Conductors and Cables."

C. Class 1 Control Cable: Multiconductor cable with stranded-copper conductors not smaller than No. 14 AWG. Comply with requirements in Section 260519 "Low-Voltage Electrical Power Conductors and Cables."

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine lighting control devices before installation. Reject lighting control devices that are wet, moisture damaged, or mold damaged.

B. Examine walls and ceilings for suitable conditions where lighting control devices will be installed.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 SENSOR INSTALLATION

A. Comply with NECA 1.

B. Coordinate layout and installation of ceiling-mounted devices with other construction that penetrates ceilings or is supported by them, including light fixtures, HVAC equipment, smoke detectors, fire-suppression systems, and partition assemblies.

C. Install and aim sensors in locations to achieve not less than 90 percent coverage of areas indicated. Do not exceed coverage limits specified in manufacturer's written instructions.

3.3 CONTACTOR INSTALLATION

A. Comply with NECA 1.

B. Mount electrically held lighting contactors with elastomeric isolator pads to eliminate structure-borne vibration unless contactors are installed in an enclosure with factory-installed vibration isolators.

3.4 WIRING INSTALLATION

A. Comply with NECA 1.

B. Wiring Method: Comply with Section 260519 "Low-Voltage Electrical Power Conductors and Cables." Minimum conduit size is 1/2 inch (13 mm).

C. Wiring within Enclosures: Comply with NECA 1. Separate power-limited and nonpower-limited conductors according to conductor manufacturer's written instructions.

D. Size conductors according to lighting control device manufacturer's written instructions unless otherwise indicated.

E. Splices, Taps, and Terminations: Make connections only on numbered terminal strips in junction, pull, and outlet boxes; terminal cabinets; and equipment enclosures.

3.5 IDENTIFICATION

A. Identify components and power and control wiring according to Section 260553 "Identification for Electrical Systems."

1. Identify controlled circuits in lighting contactors.

2. Identify circuits or luminaires controlled by photoelectric and occupancy sensors at each sensor.

B. Label time switches and contactors with a unique designation.

3.6 FIELD QUALITY CONTROL

A. Testing Agency: Engage a qualified testing agency to evaluate lighting control devices and perform tests and inspections.

B. Manufacturer's Field Service: Engage a factory-authorized service representative to test and inspect components, assemblies, and equipment installations, including connections.

C. Perform the following tests and inspections with the assistance of a factory-authorized service representative:

1. Operational Test: After installing time switches and sensors, and after electrical circuitry has been energized, start units to confirm proper unit operation.

2. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

D. Lighting control devices will be considered defective if they do not pass tests and inspections.

E. Prepare test and inspection reports.

3.7 ADJUSTING

A. Occupancy Adjustments: When requested within 12 months from date of Substantial Completion, provide on-site assistance in adjusting lighting control devices to suit actual occupied conditions. Provide up to two visits to Project during other-than-normal occupancy hours for this purpose.

1. For occupancy and motion sensors, verify operation at outer limits of detector range. Set time delay to suit Owner's operations.

2. For daylighting controls, adjust set points and deadband controls to suit Owner's operations.

3. Align high-bay occupancy sensors using manufacturer's laser aiming tool.

3.8 SOFTWARE SERVICE AGREEMENT

A. Technical Support: Beginning at Substantial Completion, service agreement shall include software support for two years.

B. Upgrade Service: At Substantial Completion, update software to latest version. Install and program software upgrades that become available within two 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.

3.9 DEMONSTRATION

A. Coordinate demonstration of products specified in this Section with demonstration requirements for low-voltage, programmable lighting control systems specified in Section 260943.16 "Addressable-Luminaire Lighting Controls" and Section 260943.23 "Relay-Based Lighting Controls."

B. Train Owner's maintenance personnel to adjust, operate, and maintain lighting control devices.

END OF SECTION 26 0923

SECTION 26 0943.13 DIGITAL-NETWORK LIGHTING CONTROLS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. System Software Interfaces.
2. System Backbone and Integration Equipment.
3. Wired Networked Devices.
4. Wireless Networked Devices.

B. Related Requirements:

1. Div. 26: Section 260010 "Supplemental Requirements for Electrical" for additional abbreviations, definitions, submittals, qualifications, testing agencies, and other Project requirements applicable to Work specified in this Section.
2. Section 260011 "Facility Performance Requirements for Electrical" for seismic-load, wind-load, acoustical, and other field conditions applicable to Work specified in this Section.
3. Section 262726 "Wiring Devices" for wired switches and dimmers and other Project requirements applicable to Work specified in this Section.

1.2 DEFINITIONS

A. Data Bus: A wired interface used to communicate with connected devices.

B. Device: A collective term for bus or wireless connected devices, including fluorescent ballasts, LED drivers, incandescent luminaires, manual switches, switching relays, sensors, and similar.

C. Global: Communication between devices in otherwise separate spaces using a bridging device or system controller.

D. Group: A set of devices that communicate together.

E. Monitoring: Acquisition, processing, communication, and display of equipment status data, metered electrical parameter values, power quality evaluation data, event and alarm signals, tabulated reports, and event logs.

F. Scene: Digital light level associated with a preset.

G. System Backbone: Devices used to connect and manage otherwise separate spaces, including bridging devices and gateways or system controllers. Used to expose devices to software configuration via TCP/IP.

1.3 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

B. Preinstallation Coordination Meeting(s): For digital-network lighting controls. Conduct meeting(s) as videoconference or at Project site before installation begins.

1. Attendees: Installers, fabricators, representatives of manufacturers, and administrants for field tests and inspections. Notify Architect, Construction Manager, and Owner's Commissioning Authority of scheduled meeting dates.
2. Engage factory-authorized service representative to attend preinstallation conference and review the submittal drawing, sequence of operation, and device installation best practices with Project team.

3. Engage factory-authorized service representative to perform cellular signal strength measurements during site walk through and compare to Project plans to verify the placement of cellular antennas and quantity of lighting control system RF access points.

1.4 ACTION SUBMITTALS

A. Product Data:

1. Bill of Materials necessary to install the networked lighting control system.
2. Product Specification Sheets indicating general device descriptions, dimensions, electrical specifications, wiring details, and nomenclature.
3. Information Technology (IT) connection information pertaining to interconnection with facility IT networking equipment and third-party systems.
4. Other Diagrams and Operational Descriptions - as needed to indicate system operation or interaction with other system(s).

B. Shop Drawings:

1. Riser Diagrams showing device wiring connections of system backbone and typical per room/area type.

1.5 INFORMATIONAL SUBMITTALS

A. Contractor Startup/Commissioning Worksheet.

B. Service Specification Sheets indicating general service descriptions, including startup, training, post-startup support, and service contract terms.

C. Field quality-control reports.

D. Sample Warranty: For manufacturer's special warranty.

1.6 CLOSEOUT SUBMITTALS

A. Maintenance Contracts:

1. Hardware and Software Operation Manuals
2. Maintenance service agreement.
3. Software service agreement.

B. Warranty documentation.

1.7 QUALITY ASSURANCE

A. Manufacturer Qualifications:

1. Phone Support: Toll-free technical support available from manufacturer through an online tool to schedule a technical support appointment and provide 24/7 emergency support.
2. Remote Support: Manufacturer capable of providing remote support and ability to virtually connect with customers to address issues with visual guidance overlaid on images of real-world objects.
3. Cellular Connectivity: Manufacturer capable of cellular connectivity to a networked lighting control systems available to provide remote support within the continental United States.
4. On-Site Support: Manufacturer capable of providing a 72-hour, on-site response time within the continental United States.
5. Service Contracts: Manufacturer capable of providing service contracts for continued on-site and remote support of the lighting control system post-installation for terms up to 10 years from substantial completion, including:

    a. Remote and on-site emergency response.
    b. Remote system performance checks.
    c. Remote diagnostics.
    d. Replacement parts.

1.8 WARRANTY

A. Warranty: Manufacturer and Installer warrant that installed lighting control devices perform in accordance with specified requirements and agree to repair or replace, including labor, materials, and equipment, devices that fail to perform as specified within extended warranty period.

1. Failures include, but are not limited to, the following:

    a. Faulty operation of lighting control hardware.
    b. Faulty operation of lighting control firmware.

2. Minimum Warranty Period: Five years from date of shipment.

PART 2 - PRODUCTS

2.1 SYSTEM COMPLIANCE

A. System components manufactured in accordance with UL 916 and UL 924 standards where applicable.

B. System components manufactured in accordance with CFR Title 47, Part 15 standards where applicable.

C. System components manufactured in accordance with ISED Canada RSS-247 standards where applicable.

D. System components manufactured in accordance with IFT-008-2015 and NOM-208-SCFI-2016 standards where applicable.

E. System listed as qualified under DesignLights Consortium Networked Lighting Control System Specification v5.0.

F. Performance Criteria:

1. Regulatory Requirements:

a. Listed and labeled in accordance with NFPA 70, by qualified electrical testing laboratory recognized by authorities having jurisdiction, and marked for intended location and application.

2.2 SYSTEM PERFORMANCE REQUIREMENTS

A. System Architecture:

1. System architecture based upon the following concepts:

a. Networkable intelligent lighting control devices.
b. Standalone lighting control zones using distributed intelligence.
c. Optional system backbone for remote, time-based, and global operation.

2. Intelligent lighting control devices with individually addressable network communication capability and having one or more basic lighting control components including: occupancy sensor, photosensor, relay, dimming output, contact closure input, analog 0-10 V(dc) input, and manual wall station capable of indicating switching, dimming, and/or scene control. Combining one or more of these components into a single device enclosure permissible to minimize overall system device count.
3. System capable of interfacing directly with networked luminaires such that either low-voltage network cabling or wireless RF communication is used to interconnect networked luminaires with control components such as sensors, switches, and system backbone.
4. Networked luminaires and intelligent lighting control devices support individual (unique) configuration of device settings and properties, with such configuration residing within the networked luminaires and intelligent control devices.
5. Lighting control zones consisting of one or more networked luminaires and intelligent lighting control devices capable of providing automatic control from sensors (occupancy and/or photosensor) and manual control from local wall stations without requiring connection to a higher-level system backbone.

a. Lighting control zones (wired and wireless) support at least 128 devices per zone.
b. Capable of being networked with a higher-level system backbone to provide time-based control, control from inputs or systems external to control zone, and remote configuration and monitoring through a software interface.

6. Networked luminaires and intelligent lighting control devices with distributed intelligence programming stored in non-volatile memory, such that following any loss of power the lighting control zones operate according to their defined default settings and sequence of operations.
7. System to include one or more system controllers that provide time-based control.
8. System controller provides means of connecting the lighting control system to a system software interface and building management systems via BACnet/IP or BACnet MS/TP protocol.
9. System controller supports both low-voltage wired and wireless RF communication within a single controller device.
10. System devices support firmware update, either remotely or from within the application space, for purposes of upgrading functionality at a later date.
11. System capable of reporting lighting system events and performance data to management software for display and analysis.

B. Wired Networked Control Zone Characteristics:

1. Connections to devices within a wired networked lighting control zone and to backbone components accomplished with a single type of low-voltage network cable, compliant with CAT5e specifications or higher. Use of mixed types of low-voltage network cables is unacceptable.
2. Devices connected in "daisy-chain" topology. "Hub-and-spoke" topology, requiring all individual networked devices to be connected to a central component, is unacceptable, to reduce the total amount of network cable required for each control zone.

3. Pre-terminated, plenum-rated, low-voltage network cabling supplied with hardware.
4. Following proper installation and provision of power, all networked devices connected with low-voltage network cable must automatically form a functional lighting control zone without requiring any type of programming, regardless of the programming mechanism (e.g. software application, handheld remote, pushbutton).

    a. The "out of box" default sequence of operation is intended to provide typical sequence of operation to minimize the system startup and programming requirements and to also have functional lighting control operation prior to system startup and programming.

5. System software capable of automatic discovery of all connected devices without requiring any provisioning of system or zone addresses.
6. Networked devices capable of detecting improper communication wiring and LED notification to alert installation/startup personnel.
7. Networked control devices suitable for control of egress or emergency light sources without additional, externally mounted UL 924 shunting or 0-10 V(dc) disconnect devices, to provide a compliant sequence of operation while reducing the overall installation and wiring costs of the system. Capable of supporting the following sequence of operation:

    a. Low-Voltage Power Sensing: Devices automatically provide 100 percent light level upon detection of loss of power sensed via low-voltage network cable connection where applicable.

b. Line-Voltage Power Sensing: Devices listed as UL 924 emergency relays which automatically close load-control relay and provide 100 percent light output upon detection of loss of power sensed via line voltage connection to normal power.

8. Global Control Zones: Networked luminaires and intelligent lighting control devices located in different areas able to transmit and track information within at least 128 system-wide control zones to support required sequences of operation that may span multiple areas. Occupancy, photosensor inhibit, and switch commands available across multiple controllers.
9. Wired Networked Wall Station Scene-Control Capabilities:

a. Preset Scenes that activate a specific combination of light levels across multiple local and global channels.
b. Local Profile Support: Profile Scenes that modify the sequence of operation for devices in the area (group) in response to a button press to dynamically optimize occupant experience and lighting energy usage.

1) Wall stations able to manually start and stop local profiles, or local profile capable of ending after a specific duration of time between five minutes and 12 hours.
2) Configurable Parameters:

a) Fixture light level.
b) Occupancy time delay.
c) Response to occupancy sensors (including enabling/disabling response).
d) Response to daylight sensors (including enabling/disabling response).
e) Enabling/disabling wall stations.

c. Three-Way or Multi-Way Control: Multiple wall stations capable of controlling the same local and global control zones, to support "multi-way" preset scene and profile scene control.

C. Wireless Networked Control Zone Characteristics:

1. No wired connections between networked devices required for the purposes of system communications.
2. Multiple wireless networking protocols supported:

a. Standards-based, distributed star topology type of protocol for 900 MHz communication, to support lighting control applications and IoT applications.
b. Bluetooth standard protocol for 2.4 GHz communication that supports direct connection to smartphone or tablet, to support device configuration, control applications, and IoT without requiring the use of a system backbone.

3. Wireless network must be self-healing, such that the loss of backbone or local communication between devices does not result in the loss of local control of lights in the space.

4. Wireless network communication must support uniform and instant response such that all luminaires in a lighting control zone respond immediately and synchronously in response to a sensor or wall station signal.
5. Communication of control signals from sensors and wall stations to networked luminaires and wireless load-control devices occur directly, without any communication, interpretation, or translation of information through a backbone device such as a wireless access point, communication bridge, or gateway.
6. All wireless communication between lighting control components supports the following five tiers of security measures.

    a. Data encryption.
    b. Firmware protection.
    c. Tamper-proof hardware.
    d. Authenticated user access.
    e. Mutual device authentication.

7. Wireless devices use AES encryption to secure communication with a unique encryption key generated for each programmed site.
8. Wireless devices use signed firmware to ensure that unmodified, authentic software is always installed.
9. Wireless networked devices capable of communicating a minimum distance of 150 ft. (45 m) between devices under typical site conditions accounting for typical environmental conditions and building construction materials encountered within commercial indoor lighting environments.
10. Minimum Line-of-Sight Communication Range: 1000 ft. (304 m) under ideal environmental conditions.
11. Wireless devices self-identify when communication to system controller cannot be accomplished or when communication to the system controller is lost.

    a. Self-identification not required for wireless switches or battery-powered devices.

12. Wireless devices self-establish connection to system controller through other devices if direct communication cannot be accomplished or when communication to system controller is lost.

    a. Communication path formation to utilize existing, wireless networked devices located between system controller and respective end devices.
    b. No additional hardware for formation of networked communication path between a system controller and end devices required.
    c. Automatic connection not required for wireless switches or battery-powered devices.

13. Networked control devices suitable for control of egress or emergency light sources without additional, externally mounted UL 924 shunting or 0-10 V(dc) disconnect devices, to provide a compliant sequence of operation while reducing the overall installation and wiring costs of the system. Capable of supporting the following sequence of operation:

a. Line-Voltage Power Sensing: Devices listed as UL 924 emergency relays that automatically close load-control relay and provide 100 percent light output upon detection of loss of power sensed via line voltage connection to normal power.
b. Normal-Power-Broadcast Sensing: Devices listed as UL 924 emergency relays that automatically close load-control relay and provide 100 percent light output upon loss of a wireless normal-power broadcast from devices connected to normal power.

D. System Integration Capabilities:

1. Capable of interface with third-party building management systems (BMS) to support two-way communication using BACnet/IP protocol, BACnet MS/TP protocol, and RESTful API including the following system integration capabilities:

a. "Write" messages for control of individual devices, including control of relay and dimming output.
b. "Write" messages for control of groups of devices through a single command, including control of relay and dimming output of all devices.
c. "Read" messages for individual device status information.

1) Available status will vary based on device type and capabilities, which may include relay state, dimming output, power measurement, occupancy sensor status, and photosensor light measurement.

d. "Read" messages for group status information for occupancy, relay state, and dimming output.
e. Activation of pre-defined system Global Profiles.

2. Activation of Global Profiles from third-party systems via dry contact closure output signals or digital commands via RS-232 or RS-485.

3. Activation of demand response levels from Demand Response Automation Servers (DRAS) via OpenADR 2.0a protocol.

E. Supported Sequence of Operations:

1. Control Zones:

a. Local Control Zones: Networked luminaires and intelligent lighting control devices installed in an area (also referred to as a group of devices) capable of transmitting and tracking occupancy sensor, photosensor, and manual switch information within at least 48 unique control zones to support different and reconfigurable sequences of operation within area. These will also be referred to as local control zones.
b. Adjacent Control Zones: Networked luminaires and intelligent lighting control devices capable of tracking occupancy broadcasts from adjacent zones. When this feature is enabled, luminaire output for a vacant zone will reduce to a configurable dimmed state if one or more adjacent zones are occupied. Luminaires will turn off when both primary and adjacent zones are vacant.

c. Global Control Zones: Networked luminaires and intelligent lighting control devices located in different areas able to transmit and track information within at least 128 system-wide control zones to support required sequences of operation that may span across multiple areas. Occupancy, photosensor inhibit, and switch commands available across multiple controllers.

2. Wall Station Capabilities:

a. Wall stations support the following capabilities:

1) On/Off of a local or global control zone.
2) Continuous dimming control of light level of a local or global control zone.

b. Multi-Way Control: Multiple wall stations capable of controlling the same local or global control zones, to support "multi-way" switching and dimming control.

3. Occupancy Sensing Capabilities:

a. Occupancy sensors configurable to control a local or global zone.
b. Multiple occupancy sensors capable of controlling the same local or global zones. This capability combines occupancy sensing coverage from multiple sensors without consuming multiple control zones.
c. Occupancy sensing sequence of operation modes:

1) On/Off Occupancy Sensing.
2) Partial-On Occupancy Sensing.
3) Partial-Off Occupancy Sensing.
4) Vacancy Sensing (Manual-On / Automatic-Off).

d. On/Off, Partial-On, and Partial-Off Occupancy Sensing Modes Sequence of Operation:

1) Occupancy automatically turn lights on to a designated level when occupancy is detected. Designated occupied light level support at least 100 dimming levels.
2) Occupancy sensors automatically turn lights off or to a dimmed state (Partial-Off) when vacancy occurs or if sufficient daylight is detected. Designated unoccupied dim level support at least 100 dimming levels.
3) System capable of combining Partial-Off and Full-Off operation by dimming lights to a designated level when vacant and turning the lights off completely after an additional time delay.
4) Photosensor readings, if enabled in occupancy sensing control zone, automatically adjust light levels during occupied or unoccupied conditions as necessary.
5) Wall station activation changes the dimming level or turn lights off as selected by the occupant. Lights optionally remain in this manually specified light level until the zone becomes vacant. Upon vacancy, normal sequence of operation resumes.

e. Vacancy Sensing or Manual-On/Automatic-Off Mode Sequence of Operation:

1) Activation of a wall station is required turn lights on. System capable of programming the zone to turn on to either a designated light level or previous user-set light level. Initially occupying the space without using a wall station must not result in lights turning on.
2) Occupancy sensors automatically turn lights off or to a dimmed state (Partial-Off) when vacancy occurs or if sufficient daylight is detected. Designated unoccupied dim level support at least 100 dimming levels.
3) System capable of dimming the lights when vacant and then turning the lights off completely after an additional time delay.
4) System capable of an "automatic grace period" immediately following detection of vacancy, during which time any detected occupancy results in the lights reverting to the previous level. After the grace period has expired, the use of a wall station is required to turn lights on.
5) Photosensor readings, if enabled in the Occupancy Sensing control zone, capable of automatically adjusting the light level during occupied or unoccupied conditions as necessary.
6) Wall station interaction changes the dimming level or turn lights off as selected by occupant. Lights remain at manually specified light level until zone becomes vacant; normal sequence of operation resumes upon vacancy.

f. Occupancy time delays before dimming or shutting off lights separately programmable for all control zones from 15 seconds to 2 hours.

4. Photosensor Sensing Capabilities (Automatic Daylight Sensing):

a. Photosensor devices configurable to control a local zone.
b. Photosensor-Based Control:

1) Continuous Dimming: Control zone automatically adjusts dimming output in response to photosenor readings, to maintain a minimum light level consisting of both electric light and daylight sources. Photosensor response configurable to adjust set point and dimming rates.

5. Schedule Capabilities:

a. System capable of time schedules for time-of-day to override devices including offsets from dusk and dawn.
b. System capable of providing a visible "blink warning" five minutes prior to the end of the schedule.
c. Wall stations may be programmed to provide timed extensions/overrides that turn the lights on for an additional time period.

1) Timed override/extension duration programmable for each individual device, zone of devices, or customized group of devices, from five minutes to 12 hours.

6. Global Profile Capabilities:

a. System capable of automatically modifying the sequence of operation for selected devices in response to any of the following:

1) Time-of-day schedule.
2) Contact closure input state.
3) Manually triggered wired wall station input.
4) RS-232/RS-485 command to wired input device.
5) BACnet input command.

b. Global Profile Capabilities:

1) Global Profiles stored within and executed from the system controller (via internal timeclock). Dedicated software host or server is not required to be online to support automatic scheduling and/or operation of Global Profiles.
2) Global Profile time-of-day schedules capable of recurrence settings including daily, specific days of week, every "n" number of days, weekly, monthly, and yearly. Lighting control global profile schedules support definition of start date, end date, end after "n" recurrences, or never ending.
3) Daylight savings time adjustments capable of being performed automatically, if desired.
4) Global Profile holiday schedules follow recurrent settings for specific U.S. holiday dates regardless if they always occur on a specific date or are determined by day/week of the month.
5) Global Profiles capable of being scheduled to run according to timed offsets relative to sunrise or sunset. Sunrise/sunset times automatically derived from location information using an astronomical clock.
6) Software management interface capable of displaying a graphic calendar view of profile schedules for each control zone.
7) Global Profiles capable of manual activation directly from system controller, specially programmed wired input devices, scene-capable wired wall stations, and software management interface.
8) Global Profiles selectable to apply to a single device, zone of devices, or customized group of devices.
9) Global Profile Configurable Parameters:

a) Fixture light level.
b) Occupancy time delay.
c) Response to occupancy sensors (including enabling/disabling response).
d) Response to daylight sensors (including enabling/disabling response).
e) Enabling/disabling of wall stations.

c. Local and Global Profiles backed up and stored on software's host server such that Profile backup can be applied to a replacement system controller or wired wall station.

7. System supports automated demand response capabilities with automatic reduction of light level to at least three levels of demand response, configurable for each output device.

2.3 SYSTEMS SOFTWARE INTERFACES

A. Management Interface:

1. Web-based management interface for remote system control, live status monitoring, and configuration of lighting control settings and schedules.
2. Compatible with industry-standard web browser clients.
3. Minimum of 100 unique password-protected user accounts.

4. Minimum of three user permission levels: read-only, read and change settings, and full administrative system access.
5. Capable of restricting access for user accounts to specific devices within the system.
6. All system devices capable of being given user-defined names.

7. Device identification information displayed in the Management interface including:

    a. Model number.
    b. Model description.
    c. Serial number or network ID.
    d. Manufacturing date code.
    e. Custom label.
    f. Parent network device.

8. Management interface capable of displaying live status of a networked luminaire or intelligent control device including:

    a. Luminaire on/off status.
    b. Dim level.
    c. Power consumption.
    d. Device temperature.
    e. PIR occupancy sensor status.
    f. Microphonic occupancy sensor status.
    g. Remaining occupancy time delay.
    h. Photosensor reading.
    i. Active Profiles.

9. Management interface capable of displaying and modifying the current active settings of a networked luminaire or intelligent control device including:

    a. Dimming trim levels.
    b. Occupancy sensor and photosensor enable/disable.
    c. Occupancy sensor time delay and light level settings.
    d. Occupancy sensor response (normal or vacancy).
    e. Photosensor setpoints and transition time delays.

10. Management interface capable of applying settings changes for a zone of devices or a group of selected devices using a single action that does not require the user to apply settings changes for each individual device.
11. Management interface capable of compiling a printable network inventory report.
12. Management interface capable of compiling a printable report detailing all system profiles.
13. All sensitive information stored encrypted.
14. System software updates available for automatic download and installation via the Internet.

B. System Energy Analysis and Reporting:

1. Intuitive graphical screens to facilitate simple viewing of system energy performance.
2. Energy Scorecard: Summarized display that indicates calculated energy savings in dollars or KWh.
3. Software calculates allocation of energy savings by control measures including occupancy sensors, photosensors, and manual switching.
4. Energy savings data calculated for the system as a whole.
5. Time-scaled graph showing all relay transitions.

6. Time-scaled graph showing zone occupancy time delays.
7. Time-scaled graph showing the total light level.
8. Software capable of storing information remotely onto an open-source, object-relational database, such as PostgreSQL.
9. Data stored in the database will be accessed utilizing an open standard, application programming interface, such as Open Database Connectivity (ODBC).

C. Visualization and Programming Interfaces:

1. System provides an optional web-based visualization interface that displays a graphical floorplan.
2. Graphical floorplan will offer the following types of system visualization:

    a. Full Device Option: Master graphic of entire building, by floor, showing each control device installed with zones outlined including:

        1) Controls embedded light fixtures.
        2) Controls devices not embedded in light fixtures.
        3) Daylight sensors.
        4) Occupancy sensors.
        5) Wall switches and dimmers.
        6) Scene controllers.
        7) Networked relays.
        8) Wired bridges.
        9) System Controllers.
        10) Wired relay panels.
        11) Group outlines.

    b. Group-Only Option: Master graphic of the entire building, by floor, showing only control groups outlined.
    c. Pan and zoom commands supported to allow smaller areas to be displayed on a larger scale simply by panning and zooming each floor's master graphic.
    d. Selecting any control device displays the following as applicable:

        1) Device catalog number.
        2) Device name and custom label.
        3) Device diagnostic information.
        4) Link to further information on device including status or current configuration.

3. Programming capabilities through the application will include the following:

    a. Switch, occupancy sensor, and photosensor zone configuration.
    b. Manual-on or automatic-on modes.
    c. Turn-on and dim to dimming levels.
    d. Occupancy sensor time delays and PIR sensitivity.
    e. Dual technology occupancy sensors sensitivity.
    f. Photosensor calibration adjustment and auto-setpoint.
    g. Multiple photosensor zone offset.
    h. Trim level settings.

i. Preset scene creation and copy for scene-capable devices.
j. Application of custom device labels to the Bluetooth Low-Energy Programming Devices and individual connected lighting control devices.
k. Fade rate settings.

D. Smartphone Programming Interface for Wired and Wireless Devices:

1. Interface provided for both Apple iOS and Android operating systems that allows configuration of lighting control settings.
2. Application supports configuration of wireless networked control devices.

a. Application access granted with valid user name and password.
b. Access to program information governed by permission system that allows users to share access with other users and restrict access to those who should not be able to reconfigure the equipment.
c. Indication of signal strength where multiple Bluetooth Low-Energy Programming Devices are available for configuration.

3. Application supports configuration or wired networked control devices.

a. Connected device access granted through user-defined passcode at initial install.
b. Indication of signal strength where multiple Bluetooth Low-Energy Programming Devices are available for configuration.

4. Programming Capabilities:

a. Switch, occupancy sensor, and photosensor group configuration.
b. Manual-on or automatic-on modes.
c. Turn-on and dim to dimming levels.
d. Occupancy sensor time delays and PIR sensitivity.
e. Dual technology occupancy sensors sensitivity.
f. Photosensor calibration adjustment and auto-setpoint.
g. Multiple photosensor zone offset.
h. Trim level settings.
i. Preset scene creation.
j. Application of custom device labels for individual connected lighting control devices.
k. Fade rate settings.

2.4 SYSTEM BACKBONE AND SYSTEM INTEGRATION EQUIPMENT

A. System Controller: Multi-tasking, real-time digital control processor consisting of modular hardware with plug-in enclosed processors, communication controllers, and power supplies.

1. Basis-of-Design Product: Subject to compliance with requirements, provide nLight; Acuity Brands Lighting, Inc.; nECY or comparable product by one of the following:

a. Cooper Industries, Inc.
b. Leviton Manufacturing Co., Inc.
c. <Insert manufacturer's name>.

2. System Controller Processor: 32-bit microprocessor operating at a minimum of 1 GHz.
3. System Controller Memory: Minimum of 512MB memory, with a minimum of 4GB non-volatile flash, to support operating system and databases.
4. System Controller Functions:

    a. Time-based control of downstream wired and wireless network devices.
    b. Linking into an Ethernet network.
    c. Integration with Building Management Systems (BMS) and Heating, Ventilation and Air Conditioning (HVAC) equipment.
    d. Connection to various software interfaces, including management interface, historical database and analytics interface, and visualization interface.

5. Integral web server to support system controller configuration and diagnostics.

    a. Web Server Control Interface:

        1) Display associated devices within the context of a graphical floorplan.
        2) Provide control of output-capable devices through virtual sliders, toggle buttons, preset level widgets, and transparent layers on floorplan.
        3) Control Capabilities:

            a) Control of individual output devices, including control of relay state and analog dimming level where applicable.
            b) Control of local lighting control zones, including control of relay state and analog dimming level where applicable.
            c) Control of global lighting control zones, including control of relay state and analog dimming level where applicable.
            d) Control of Global Profiles.

    b. Visualization Interface:

        1) Customizable display with the ability to superimpose colored, transparent layers representing real-time property values, including occupancy status, dimming level status, light level status, and online or offline status where applicable.
        2) Ad hoc display of trended information via an intuitive values-over-time graph.
        3) Report Creation:

            a) Reports accept and graphically display trended status datasets for creator selected devices or zones of devices.
            b) Report information displayed over a user-defined interval and date range.
            c) Reports exportable to a standard CSV format.

6. Graphical touch screen to support configuration and diagnostics.
7. Minimum of three RJ-45 networked lighting control ports for connection to any of the following:

    a. Graphical touch screen.
    b. Wired communication bridges.
    c. Direct connection to networked wired luminaires and intelligent lighting control devices (up to 128 total devices per port).

8. Device will automatically detect all network-connected devices.
9. Capable of managing and operating a minimum of 750 networked devices (wired or wireless) per system controller.
10. Multiple System Controllers capable of connection via LAN for scalability to a minimum of 20,000 networked devices.
11. Supports BACnet/IP and BACnet MS/TP protocols to directly interface with BMS and HVAC equipment without additional protocol translation gateways.

a. BACnet MS/TP Connection Speed: 9600 to 115200 baud rate.
b. BACnet Testing Laboratory (BTL listed) using Device Profile BACnet Building Controller (B-BC) with outlined enhanced features.

12. Integral FIPS 140-2, Level 1 cryptographic module.
13. Supports RESTful API for control of BACnet objects, user management, date and time, and file management.
14. NEMA 1 enclosure with Class 1 and Class 2 separation.

a. Power Supply Voltage: 120 to 277 347 V(ac).

15. Automatic algorithm to eliminate redundant, wireless networked paths to streamline communication between the system controller and end devices.
16. System Controller Security Provisions:

a. Disallow the use of default passwords and require passwords to be updated prior to use.
b. Support user role-based access, such as administrator, user, and viewer.
c. Signed firmware to ensure that unmodified, authentic software is always installed.
d. IP-based communication protected with strong encryption algorithms such as AES or TLS1.2+.
e. Prevent rollback of firmware to firmware versions with known, critical vulnerabilities.
f. Valid cybersecurity listing through a third party.

17. Cellular Remote Access: Cellular router and modem for remote access.

a. Router supports remote access to at least five system controllers on its local area network or network subnet.
b. Remote access capable of device setting updates, schedule updates, system performance optimization, and diagnostics.
c. Remote access enabled through outbound communication from router to an outside source. Solutions that begin communication via inbound requests for network access are unacceptable.
d. Router supports outbound communication to manufacturer-hosted portal using TLS1.2 or greater in-transit encryption over a cellular or Ethernet connection.
e. Router with integral firewall to prevent unauthorized access to devices connected to its local area network port.
f. Router includes cellular SIM capable of connection to AT&T, T-Mobile, Sprint, US Cellular, Alaska Wireless, Telefonica, Tellus, Bell, or Sasktel networks where carrier service is available.
g. Outbound communication from the router limited to whitelisted endpoints. Devices that allow unrestricted communication are unacceptable.
h. Outbound communication from router includes only lighting control system information.

2.5 WIRED NETWORKED DEVICES

A. Wired Networked Wall Switches, Dimmers, Scene Controllers:

1. Basis-of-Design Product: Subject to compliance with requirements, provide nLight; Acuity Brands Lighting, Inc.; or comparable product by one of the following:

    a. Cooper Industries, Inc.
    b. Leviton Manufacturing Co., Inc.

2. Mounting: Suitable for installation in single-gang switch box.
3. Communication and low-voltage power delivered via standard low-voltage network cabling with RJ-45 connectors.
4. All switches detect valid communication and blink a unique LED pattern to visually indicate a potential wiring issue.
5. Devices with mechanical push buttons provide tactile and LED user feedback.
6. Devices with mechanical push buttons manufactured with custom button labeling.
7. Wall switch and dimmer options:

    a. Number of control zones: 4.
    b. Control Types Supported:

        1) On/Off.
        2) On/Off/Dimming.

    c. Color: Light Almond.

8. Scene Controller Options:

    a. Number of Scenes: 4.
    b. Control Types Supported:

        1) On/Off.
        2) On/Off/Dimming.
        3) Preset Level Scene Type.
        4) On/Off/Dimming/Preset Level for Correlated Color Temperature.
        5) Reprogramming of other devices within daisy-chained zone to implement user-selected lighting scene including manual start/stop from the scene controller, or optionally programmed automatic stop after a user-selectable duration between five minutes and 12 hours.
        6) Selecting a lighting profile to be run by device's upstream controller to implement a selected lighting profile across multiple zones including manual start/stop from the scene controller, or optionally programmed automatic stop after a user selectable duration between five minutes and 12 hours.

    c. Color: Light Almond.

B. Networked Graphic Wall Stations:

1. Basis-of-Design Product: Subject to compliance with requirements, provide nLight; Acuity Brands Lighting, Inc.; nPOD TOUCH or comparable product by one of the following:

a. Cooper Industries, Inc.
b. Leviton Manufacturing Co., Inc.

2. Mounting: Suitable for installation in single-gang switch box.
3. Integral 3.5-inch (88 mm) capacitive full-color touch screen.
4. Power via polarity insensitive Class 2 low-voltage 15 to 24V (dc) power supply.
5. Device enables mobile application control of control zones and scenes through Bluetooth.
6. Communication over standard low-voltage network cabling with RJ-45 connectors.
7. User-customizable screen saver utilizing uploaded image file in common file format including jpg, png, gif, bmp, or tif.
8. Capable of configuration of all switches, dimmers, control zones, and lighting preset scenes via password-protected setup screens.
9. Graphic Wall Station Options:

a. Number of Control Zones: Up to 16.
b. Number of Scenes: Up to 16.
c. Profile Scene Duration: User configurable from five minutes to 12 hours.
d. Color: White.

C. Digital Time Clock:

1. Basis-of-Design Product: Subject to compliance with requirements, provide nLight; Acuity Brands Lighting, Inc.; nDTC or comparable product by one of the following:

a. Cooper Industries, Inc.
b. Leviton Manufacturing Co., Inc.

2. Controls a linear bus of lighting devices suppling all time functions without connection to a system controller.

a. Programming of the linear bus of lighting devices must not require additional hardware, including computers, specialized dongles, or other connection devices.
b. Programming of the linear bus exclusively done through the touch-screen interface.

3. Capable of up to 32 schedules. Each schedule consists of one set of On and Off times per day for each day of the week and for each of two holiday lists. Schedules assignable to any individual relay or group of relays.
4. Operates from non-volatile memory so that all system programming is retained indefinitely.

5. Mounted inside a relay panel to eliminate the necessity for additional enclosures for complete installation.
6. Capacitive 3.5-inch (88 mm), full-color touch screen.

D. Wired Networked Digital Key Switches:

1. Basis-of-Design Product: Subject to compliance with requirements, provide nLight; Acuity Brands Lighting, Inc.; nPODA KEY or comparable product by one of the following:

a. Cooper Industries, Inc.
b. Leviton Manufacturing Co., Inc.

2. Mounting: Suitable for installation in single-gang switch box.
3. Communication and low-voltage power delivered via standard low-voltage network cabling with RJ-45 connectors.
4. All switches detect valid communication and blink a unique LED pattern to visually indicate a potential wiring issue.
5. LED user feedback to provide indication of on/off status of the programmed lights or scene, as well as indication of device power.
6. Digital Key Switch Options:

    a. Control Types Supported:

        1) On/Off.
        2) On/Off/Dimming.
        3) Preset Level Scene Type.
        4) On/Off/Dimming/Preset Level for Correlated Color Temperature.

5) User-programmed local lighting scene run within a daisy-chained group including manual start/stop from the switch, or optionally programmed automatic-stop after a user-selectable duration between five minutes and 12 hours.
6) User-programmed global lighting profile run by an upstream controller across multiple groups including manual start/stop from the switch, or optionally programmed automatic-stop after a user-selectable duration between five minutes and 12 hours.

b. Color: Light Almond.

E. Wired Networked Auxiliary Input / Output (I/O) Devices:

1. Basis-of-Design Product: Subject to compliance with requirements, provide nLight; Acuity Brands Lighting, Inc.; nIO series or comparable product by one of the following:

a. Cooper Industries, Inc.
b. Leviton Manufacturing Co., Inc.

2. Plenum rated.
3. Mounting: extended chase nipple for mounting to a 1/2-inch (16 mm) knockout.
4. Communication and low-voltage power delivered to each device via standard low-voltage network cabling with RJ-45 connectors.
5. Auxiliary Input/Output Devices Options:

a. Contact closure or pull-high input.

1) Input programmable to support maintained or momentary inputs that can activate local or global scenes and profiles, activate lights at a preconfigured level, ramp light level up or down, or toggle lights on/off.

b. 0-10V analog input.

1) Input supports zero to 10 V dimming output control from a dimmer switch.
2) Input programmable to function as a daylight sensor.

c. RS-232/RS-485 digital input.

1) Input supports activation of up to four local or global scenes and profiles, and on/off/dimming control of up to 16 local control zones.
2) Provides relay and dimming level status to external device (e.g. Touchscreen) when polled.

d. 0-10V dimming control output, capable of sinking up to 20mA.

1) Output programmable to support all standard sequence of operations supported by system.

e. Digital control output via eldoLED LEDcode communication.

1) Output programmable to support light intensity control, as well as optional correlated color temperature (CCT) control, of the connected luminaire.

F. Wired Networked DMX Interface Stations:

1. Basis-of-Design Product: Subject to compliance with requirements, provide nLight; Acuity Brands Lighting, Inc.; nPWDMX or comparable product by one of the following:

   a. ETC.
   b. Lutron.

2. Description: Multi-protocol, bidirectional DMX512 playback (snapshot) and lighting control gateway.

   a. Capable of control of networked luminaire or all normal power lighting load types.
   b. Capable of control of DMX lighting through:

      1) DMX input for snapshot capture of lighting presets.
      2) Live control of intensity, hue, and saturation of configured DMX Zones from connected stations.

   c. Integral LED indicators for power, network traffic, processor health, identify, DMX port configuration and status.
   d. Support recall of up to 16 (total):

      1) Prerecorded scenes/snapshots for playback.
      2) DMX zones.

   e. Capable of preset playback as activated by any connected control station.
   f. Capable of DMX pass-through for real-time output of incoming DMX levels.
   g. Support four universes of ANSI E1.31 sACN-Streaming ACN (sACN), including priorities, for snapshot capture and recall.
   h. Support ANSI E1.20 RDM with PC-based software.
   i. Act as an ANSI E1.33 RDMnet controller.

3. General Requirements:

   a. Operating Voltages:

      1) PoE Class 2 Device.
      2) 24 V(dc) (not used if using PoE), 7 W maximum power consumption.

   b. Operating Temperature: Minus 32 to plus 113 deg F (0 to 45 deg C).

   c. DIN-Rail Mounted on DIN 43880 (35/7.5) rail.
   d. NEMA Type 1 enclosure.

      1) Enclosure Size: 10 inches (260 mm) wide by 13 inches (330 mm) high by 4.5 inches (114 mm) deep.

4. Features:

   a. Lighting control ports supports:

1) Communication through lighting control (RJ-45) ports that supply 40 mA of power to each device via standard Category 5e low-voltage network cabling.
2) Detection of valid communication and blinking of a unique LED pattern to visually indicate a potential wiring issue.

b. DMX Ports:

1) Comply with the requirements of ANSI E1.11 USITT DMX512-A standards.
2) Configurable as Input or Outputs.
3) Support ANSI E1.31 sACN.
4) Support Pathway Secure Streaming ACN (ssACN).
5) Comply with California Title 1.81.26.
6) Comply with ANSI E1.20 RDM.
7) Capable of withstanding fault voltages of up to 250 V(ac) without damage.

c. Dry contact closure input to connect with external control systems to control a lighting control zone or scene.

d. Ethernet Ports:

1) Support IEEE 802.3af Power-over-Ethernet in absence of 24 V(dc).
2) Support auto-negotiated 10/100MB connections speeds.
3) Support IEEE 802.1AB Link Layer Discovery Protocol.

e. Test Functions:

1) Operate without need of a configuration PC to check local wiring.
2) Test connectivity with DMX lights and networked luminaire or all normal power lighting load types.

f. Complies with the following:

1) RoHS 2011/65/EU + A1 2015/863.
2) FCC.

G. Wired Networked Occupancy and Photosensors:

1. Basis-of-Design Product: Subject to compliance with requirements, provide nLight; Acuity Brands Lighting, Inc.; or comparable product by one of the following:

a. Cooper Industries, Inc.
b. Leviton Manufacturing Co., Inc.

2. Detect the presence of human activity within space and fully control the on/off function of lights.
3. Utilize passive infrared (PIR) technology, which detects occupant motion, to initially turn lights on from an off state, thus preventing false on conditions. Ultrasonic and Microwave-based sensing technologies are unacceptable.
4. Dual technology sensors used in locations where a second method of sensing is necessary to adequately detect maintained occupancy (such as in rooms with obstructions).

5. Dual technology sensors must have one sensing technology not motion dependent to detect occupancy. Acceptable dual technology includes PIR/Microphonics (also known as Passive Dual Technology or PDT), which detects both occupant motion and sounds indicating occupants. Sensors where both technologies detect motion (PIR/Ultrasonic) are unacceptable.

6. All sensing technologies are 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 and hearing devices). Acceptable detection technologies include Passive Infrared (PIR), and/or Microphonic technology. Ultrasonic and Microwave-based sensing technologies are unacceptable.
7. Ceiling, fixture, recessed, and corner mounted sensors available, with multiple lens options available customized for specific applications.
8. Communication and low-voltage power delivered to each device via standard low-voltage network cabling with RJ-45 connectors.
9. All sensors detect valid communication and blink a unique LED pattern to visually indicate a potential wiring issue.
10. Sensor programming parameter available and configurable remotely from the software and locally via the device push button.

11. Ceiling mount occupancy sensors include one integrated dry contact switching relay, capable of switching 1 A at 24 V, resistive only.
12. Sensors available with one or two occupancy "poles," each of which provides a programmable time delay.

13. Photosensor/daylight override, automatic dimming control, and low temperature/high humidity operation.
14. Photosensor provide one on/off set-point and include a dead band to prevent the artificial light from cycling. Delay incorporated into the photosensor to prevent rapid response to passing clouds.
15. Photosensor and dimming sensor's set-point and dead band 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 or modified.
16. Dead band setting 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).
17. Dual zone option available for On/Off Photosensor, Automatic Dimming Control Photosensor, or Combination units. The secondary daylight zone capable of being controlled as an "offset" from the primary zone.

H. Wired Networked Wall Switch Sensors:

1. Basis-of-Design Product: Subject to compliance with requirements, provide nLight; Acuity Brands Lighting, Inc.; or comparable product by one of the following:

    a. Cooper Industries, Inc.
    b. Leviton Manufacturing Co., Inc.

2. Mounting: Suitable for installation in single-gang switch box.
3. Communication and low-voltage power delivered via standard low-voltage network cabling with RJ-45 connectors.
4. All switches detect valid communication and blink a unique LED pattern to visually indicate a potential wiring issue.
5. Devices with mechanical push buttons provide tactile and LED user feedback.

6. Wall Switch Sensor Options:

    a. User Input Control Types: On/Off/Dimming.
    b. Occupancy Sensing Technology: Dual technology acoustic.
    c. Daylight Sensing Option: Inhibit Photosensor.
    d. Color: Light Almond.

I. Wired Networked Embedded Fixture Sensors:

1. Basis-of-Design Product: Subject to compliance with requirements, provide nLight; Acuity Brands Lighting, Inc.; nES or comparable product by one of the following:

    a. Cooper Industries, Inc.
    b. Leviton Manufacturing Co., Inc.

2. Network system sensors with occupancy sensors and/or dimming photosensors that can be embedded into luminaire such that only the lens shows on luminaire face.
3. Occupancy sensor detection pattern suitable for 7.5 to 20-ft. (2.2 to 6-m) mounting heights.
4. Embedded Sensor Options:

    a. Occupancy Sensing technology: Dual technology acoustic.
    b. Sensing Option: Occupancy only.

J. Wired Networked Power Packs:

1. Basis-of-Design Product: Subject to compliance with requirements, provide nLight; Acuity Brands Lighting, Inc.; nPP16 series or comparable product by one of the following:

    a. Cooper Industries, Inc.
    b. Leviton Manufacturing Co., Inc.

2. Plenum rated.
3. Communication will be delivered to each device via standard low-voltage network cabling with RJ-45 connectors.
4. Supply Voltage: [120 to 277] V(ac).
5. Relay Output: Class 1 relay rated for 16 A at [277] V(ac) and 1/2 HP at 120 V(ac).
6. Dimming Output: 0-10 VDC Dimming output.
7. Sink Current: 100 mA at 0-10 V(dc).
8. Mounting: Integral 1/2-inch (16-mm) chase nipple. Plastic clips into junction box are

K. Wired Networked Bluetooth Low-Energy Programming Device:

1. Basis-of-Design Product: Subject to compliance with requirements, provide nLight; Acuity Brands Lighting, Inc.; nIO BT or comparable product by one of the following:

    a. Cooper Industries, Inc.
    b. Leviton Manufacturing Co., Inc.

2. Plenum rated, inline wired, and screw mountable.
3. Communication and low-voltage power delivered to device via standard low-voltage network cabling with RJ-45 connectors.
4. Bluetooth communication allows connection from smartphone application for programming device settings within the local daisy-chain zone.
5. Device provides visual indication of remote Bluetooth connection via LED integrated into device enclosure such that it is visible from all angles while the zone is being programmed.

L. Wired Networked Communication Bridge:

1. Basis-of-Design Product: Subject to compliance with requirements, provide nLight; Acuity Brands Lighting, Inc.; nBRG or comparable product by one of the following:

   a. Cooper Industries, Inc.
   b. Leviton Manufacturing Co., Inc.

2. Suitable for surface mount to a standard 4 by 4-inch (100 by 100 mm) square junction box.
3. Communication Ports: Eight RJ-45 ports for connection to lighting control zones (up to 128 devices per port), additional network bridges, and System Controller.
4. Capable of aggregating communication from multiple lighting control zones for purposes of minimizing backbone wiring requirements back to System Controller.
5. Power Input: Class 2 low-voltage supplied locally via a directly wired power supply.
6. Wired Bridge capable of redistributing power from its local supply and connected lighting control zones with excess power to lighting control zones with insufficient local power. Architecture enables loss of power to a particular area to be less impactful on network lighting control system.

PART 3 - EXECUTION

3.1 INSTALLATION OF WIRING

A. Wiring Method: Comply with Section 260519 "Low-Voltage Electrical Power Conductors and Cables" and Section 260523 "Control-Voltage Electrical Power Cables." Minimum conduit size is 1/2 inch (13 mm).

1. Comply with requirements for cable trays specified in Section 260536 "Cable Trays for Electrical Systems."
2. Comply with requirements for raceways and boxes specified in Section 260533.13 "Conduits for Electrical Systems," and Section 260533.16 "Boxes and Covers for Electrical Systems,"

B. Wiring within Enclosures: Bundle, lace, and train conductors to terminal points with no excess and without exceeding manufacturer's limitations on bending radii. Install lacing bars and distribution spools.

3.2 IDENTIFICATION

A. Identify system components, wiring, cabling, boxes, cabinets, and terminals. Comply with identification requirements specified in Section 260553 "Identification for Electrical Systems."

B. Identify field-installed conductors, interconnecting wiring, and components; install warning signs complying with Section 260553 "Identification for Electrical Systems."

C. Identify all controls with device address.

D. Label each device cable within 6 inch (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. Field tests and inspections must be witnessed by Architect.

C. Tests and Inspections: Perform test inspections.

1. Test each zone using local and remote control hardware.
2. Perform each visual and mechanical inspection and electrical test stated in NETA ATS. Certify compliance with test parameters.

D. Nonconforming Work:

1. Lighting controls will be considered defective if they do not pass tests and inspections.
2. Correct malfunctioning units on-site, where possible, and retest to demonstrate compliance; otherwise, replace with new units and retest.

E. Field Test Reports: Prepare field test reports.

1. Prepare functionality and inspection reports, including a certified report that identifies controls included and describes test results. Include notation of deficiencies detected, remedial action taken, and observations made after remedial action.
2. Include list of all points created from actual tests of all addressed control points for lamps, ballasts, manual controls, and sensors.

3.4 REMOTE ACCESS

A. Digital network lighting control system capable of remote access by manufacturer with the following features:

1. System diagnostics including detection of fault condition in hardware or connected devices.
2. Access to all connected devices for complete programming including scheduling of time-of-day events and device parameters necessary to meet required sequence of operations.
3. Browser-based interface to verify system functionality.
4. On-demand access to manufacturer technical support for remote troubleshooting, diagnostics, configuration, and programming.
5. Owner training on the digital network lighting control system available remotely.

B. Remote access system fully functional over commercial celluar connection or Internet-connected ethernet network.

C. All hardware associated with remote access including cellular modem and cellular antenna are to remain on-site regardless of warranty or cellular contract status.

3.5 SYSTEM STARTUP

A. Perform startup service.

1. Complete installation and startup checks in accordance with manufacturer's published instructions.
2. Activate luminaires and verify that all maximum output levels match output levels detailed in an Owner-approved sequence of operations.
3. Confirm correct communications wiring, initiate communications between control devices and controller/gateways, and program the lighting control system in accordance with approved configuration schedules, time-of-day schedules, and input override assignments.
4. Program network devices to meet required sequence of operations.
5. Program and verify all sequence of operations.
6. Create backup of system programming.
7. Assist in installation of system software on customer-provided workstation or server.

8. Verify bidirectional communication of manufacturer-provided cellular router with manufacturer-managed remote access portal.

3.6 CLOSEOUT ACTIVITIES

A. Enhanced Documentation: Engage lighting system manufacturer to provide comprehensive system documentation including detailed programming, sequence of operation data per Project specifications, and related code requirements.

B. Training: Engage lighting system manufacturer to provide comprehensive system overview, software overview, and documentation relating to system operation and maintenance.

3.7 PROTECTION

A. After installation, protect digital network lighting controls from construction activities. Remove and replace items that are contaminated, defaced, damaged, or otherwise caused to be unfit for use prior to acceptance by Owner.

3.8 MAINTENANCE

A. Engage a factory-authorized service representative to perform on-site system adjustments.

1. On-Site Occupancy Adjustments: When requested within 12 months from date of Substantial Completion, provide on-site settings adjustments to suit actual occupied conditions. Provide up to two visits to Project during other-than-normal occupancy hours for this purpose.
2. Prepare and submit report after each visit that details activities performed.

B. Engage a factory-authorized service representative to perform remote system adjustments.

1. Remote Occupancy Adjustments: When requested within 12 months from date of Substantial Completion and project registration with lighting control system manufacturer, provide remote settings adjustments to suit actual occupied conditions. Provide up to 2 sessions to Project during other-than-normal occupancy hours for this purpose.

a. System to include manufacturer-provided cellular communication hardware and connection to the system for a minimum of 12 months after substantial completion to allow for factory representative assistance with settings adjustments and system sustainment.
b. For the remaining duration of the maintenance term, or in the event cellular connectivity is not available, manufacturer assistance must be available through an Owner-provided, Internet-connected network.

2. Prepare and submit report after each session that details activities performed.

C. Maintenance Service Agreement:

1. Beginning at Substantial Completion, verify that maintenance service agreement includes 12 months' full maintenance by manufacturer's authorized service representative.
2. Preventative maintenance to include:

a. System diagnostic reports.
b. System performance checks.
c. Device firmware updates.
d. Programming adjustment as required for proper lighting system operation.
e. Expedited factory direct warranty processing, replacement, and programming of defective components.

3. Verify that parts and supplies are manufacturer's authorized replacement parts and supplies.

END OF SECTION 260943.13

SECTION 26 1839 - MOTORS AND MOTOR STARTERS

PART 1 - GENERAL

1.1 WORK INCLUDED

Furnish all labor, materials, equipment, appliances, and perform all operations in connection with, and complete in strict accordance with, this section of specifications and the applicable drawings and subject to the terms and conditions for the contract for the following work:

A. Motor

B. Motor Starters (Stand Alone)

1.2 RELATED WORK

A. The General Conditions, Supplementary General Conditions, Special Conditions, Alternates and Addenda, applicable drawings and the technical specifications herein shall apply to all work under this Division 26, including but not limited to the following:

1. Section 260500 – Electrical General Requirements
2. Section 260120 – Basic Materials and Methods
3. Section 262416 – Distribution Switchboard
4. Section 261816 – Enclosed Switches and Circuit Breakers
5. Section 260526 – Grounding and Bonding

B. The Contractor shall be familiar with all sections of these electrical specifications. He shall adapt his work to the work required of other trades to effect a complete and working system. Where this Contractor furnishes equipment, materials or installation which comprises a part of another Contractor's system, the item so furnished shall meet or exceed the requirements imposed on the other systems.

1.3 SHOP DRAWINGS / SUBMITTALS

A. Furnish complete working shop drawings of all control system. Reference design documents for sequence, basic components, suggested piping, wiring, and dimensions. Review the project with the Engineer prior to making submittal. Submit manufacturer's data sheets for all equipment, devices and materials.

B. After initial review, make corrections requested and resubmit in clean format. Work only from final review set.

C. Maintain record drawings in the field. Clean up originals at completion of work and resubmit for Owner's use in operation of the systems.

1.4 CONTRACTOR QUALIFICATIONS

A. The Contractor shall be licensed as such in the Contractor state of origin and in the state where the work is performed.

B. All workmen on the project shall be licensed journeymen, qualified in electrical work as appropriate. The state apprentice/journeyman ratio shall be adhered to at all times. When there is electrical work being done the journeyman must be at the site.

C. Acceptable Electric/Electronic Product Lines: Honeywell, Brown, Johnson Controls, Penn, Staefa (Institutional grade), other specific products noted.

1.5 CONTROL SEQUENCES

A. Control sequences are as indicated in the Elementary Control Diagrams on the drawings.

B. Clarification of any function or device of any system not fully understood or recognized as being undefined should be requested form the Engineer during the bidding period.

1.6 CLEANING AND LUBRICATION

All instruments and control panel shall be thoroughly cleaned by this Contractor before final acceptance. This Contractor shall provide lubrication for all equipment furnished by him.

1.7 TESTING AND ADJUSTING OF SYSTEM

A. During the testing and balancing of the various building systems this Contractor shall have a representative present and available to adjust controls as required. The integrity and accuracy of each function and control point shall be demonstrated and reported.

1.8 CODES AND STANDARDS

A. The following standards shall be considered to be part of this specification insofar as they give definitions and describe requirements and tests which equipment supplied shall meet. They shall be the latest edition, including any addenda, supplements, or revisions thereto, in effect at the time of award of the purchase order. The equipment shall also meet any laws or requirements of the State or other regulatory bodies having jurisdiction over such apparatus, unless otherwise specified.

1. ANSI C57.13 – Requirements for Instrument Transformers
2. ANSI C89.1 (NEMA ST1) – Specialty Transformers (except General Purpose Type)
3. NEMA AB-1 – Molded Case Circuit Breakers
4. NEMA ICS1 – General Standards for Industrial Control and Systems
5. NEMA ICS2 – Industrial Control Devices, Controllers and Assemblies
6. ANSI C1 (NFPA 70) –National Electrical Code
7. UL 489 – Molded Case Circuit Breakers and Circuit Breaker Enclosures
8. UL 508 – Industrial Control Equipment
9. UL 845 – Standard for Motor Control Centers
10. UL 1053 – Ground Fault Sensing and Relaying Equipment
11. MSHA – Mine Safety and Health Administration
12. International Building Code – IBC
13. National Electrical Code – NEC

1.9 REQUIREMENTS OF REGULATORY AGENCIES

A. Provide motor starters of the appropriate NEMA size.

PART 2 - PRODUCTS

2.1 MOTORS

A. Motors having ratings of between 2- and 30-horsepower (HP) shall be of the energy-efficient type; having an efficiency rating of not less than 90 percent whether or not motors are separately provided or included in equipment assemblies specified in other sections of this specifications. Each motor shall conform to the HP and voltage ratings indicated, and shall have a service factor-rating and other characteristics that are essential to the proper application and performance of the motors under conditions shown or specified. Unless otherwise specified, all motors shall have open frames, and continuous-duty classification based on a 40-degree C ambient temperature reference. Polyphase motors shall be squirrel-cage type, having normal-starting-torque and low-starting-current characteristics, unless other characteristics are specified in other sections of these specifications or shown on the contract drawings. The Contractor shall be responsible for selecting the actual horse power ratings and other requirements necessary for the applications indicated. When electrically driven equipment furnished under other sections of these specifications materially differs from the design, the Contractor shall make the necessary adjustments to the wiring, disconnect devices and branch-circuit protection to accommodate the equipment actually installed.

2.2 MOTOR CONTROL

A. Each motor of 1/8-hp or larger shall be provided with thermal-overload protection. Polyphase motors shall have solid state overload protection in each ungrounded conductor. The overload-protection device shall be provided integral with the motor or controller. Unless otherwise specified, the protective device shall be of the manually reset type. single or double-pole tumbler switches specifically designed for alternating-current operation only may be used as manual controllers for single phase motors having a current not in excess of 80 percent of the switch rating. Automatic control devices such as themostats, float or pressure switches may control the starting and stopping of motors directly, provided the devices used are designed for that purpose and have an adequate horsepower rating. When the automatic control-device does not have such a rating, a magnetic starter shall be used, with the automatic-control device actuating the pilot control circuit. When combination manual-and-control devices are specified and the automatic control device operates the motor directly, 2-momentary type control switches marked stop start shall be provided for the manual control. Connections to the selector shall be such that the automatic regulatory control device (i.e. sump low level) shall disable the system in the event of an alarm. All safety control devices shall be connected in the motor control circuit.

2.3 AC MAGNETIC STARTERS - LINE VOLTAGE TYPE

A. General:

1. Motors starters shall be of the across-the-line magnetic type rated in accordance with NEMA standards, sizes and horsepower ratings. Starters shall be mounted in enclosures of the type indicated on the plans.

B. Contacts:

1. Across-the-line magnetic starters through NEMA size seven shall be equipped with double break silver alloy contacts. Single break contacts shall be supplied on size eight. All contacts shall be replaceable without removing wiring or removing

the starter from the panel. The starter must be equipped for straight through wiring only. Starters over size 3 shall be Joslyn Clarke vacuum contactors.

C. Coils:

1. Coils shall be molded construction through NEMA size seven. All coils shall be replaceable from the front without removing the starter from the panel.

D. Overload Relays

1. Overload relays shall be of the solid state type with: phase loss, phase reversal, 3Ø overcurrent, 3Ø undercurrent, 3Ø over voltage, 3Øunder voltage and ground fault. The starter shall be inoperative if the unit is removed.

E. Auxiliary Contacts:

1. NEMA size 0 - 7 starters shall be equipped to incorporate an addition of at least 4, external auxiliary contacts of any arrangement, normally open or normally closed. Size 0 - 7 auxiliary contacts shall be field interchangeable.

F. Three-phase Starter requirements:

1. All magnetic starters shall be of the 3-phase, 3-pole, 60Hz, of the applicable NEMA size. Starters shall be equipped with solid state overload relays, pilot light, and handoff automatic control switch, mounted in the door of the enclosure. See control diagrams for pilot and control requirements, 120 VAC coil and control power transformer. Starters shall also be equipped with 2 normally open and 2 normally closed auxiliary contact, and indicating pilot light. See detailed control drawings for all pilot and control requirements.

G. All starters shall be rated and labeled per International Building Code and National Electrical Code for seismic zone 2.

H. Approved Manufacturers:

a. Square D

b. Allen Bradley

c. Siemens

d. Cutler Hammer

e. GE

I. Painting:

a. Motor control center shall be painted in accordance with the Vendor's standard specification.

b. A sufficient quantity of touch-up paint shall be furnished.

J. Shipping, Handling and Storage:

a. Preparation for shipment shall protect the equipment and accessories against corrosion, dampness breakage or vibration injury in transportation and handling. Packaging shall prevent tampering or pilfering and shall be approved and accepted by transportation companies.

b. Each shipping section shall be provided with suitable steel section supports, lifting eyes, etc., to maintain alignment of parts during shipping, handling, hoisting and installation. The location of lifting points shall be clearly identified on shipping containers and on drawings. Each shipping section shall have its weight clearly marked on the container.

c. Necessary bus connections, wire jumpers, bolts, nuts, washers, etc., shall be furnished, suitably packaged and marked to facilitate field assembly. Each shipping container

shall be identified with the name of contents, purchase order number and purchase order item number.

K. Inspection and Testing:

a. Design Test:

1. Motor control centers, each size combination motor starter unit, contactors and feeder breakers shall be tested for adequacy of design in accordance with NEMAICS 2 and UL 845. The Vendor at the time of bid shall provide design test documentation certifying that all equipment provided has been tested in accordance with ANSI, NEMA, UL, ICS 2-322.41 AND 322.42 and the results of the tests prove that all equipment meets ratings and requirements of the industry codes and standards.

b. Production and Conformance Tests:

1. Owner's inspector has the right to inspect, at all reasonable times and at all locations, including subcontractor's premises, during fabrication and assembly, and to witness all testing and quality control procedures which may take place during fabrication and final testing.

2. The Vendor shall perform all standard production and conformance tests including applicable NEMA, ANSI, and UL standard and functional tests to ensure proper function, performance, and operation of the supplied equipment.

c. Witnessed Testing:

1. The final inspections and tests may be conducted on each motor control center assembly in the presence of the Owner's authorized representatives. The motor control center assembly shall be complete with all components installed. Any discrepancies found as a result of the inspections or tests shall be corrected by the Vendor at no cost to the Owner (including the cost of test time for making the corrections and repeating the tests and/or inspections)

2. The Purchaser's authorized representative shall be permitted to inspect the motor control center assemblies for compliance with this specification, the industry standards, the manufacturer's standards and the MCC drawings.

L. Equipment Data Sheet:

a. The Vendor shall provide the following:

1. Descriptive literature and/or pamphlets covering circuit breakers, magnetic contactors, overload relays, control and instrument transformers, transducers, and instruments.

2. Descriptive literature and/or pamphlets covering the design and general construction of the motor control centers, overall dimensions, layout, etc.

3. Information on terminal clocks, nameplates, etc., normally used for this type of equipment.

2.4 COMBINATION MAGNETIC STARTERS

A. General

1. Combination starters shall be manufactured in accordance with the latest published NEMA standards, sizes, and horsepower ratings. Circuit breaker type combination

starters shall consist of a circuit breaker and a motor starter. Combination starters shall be mounted in the MCC or as indicated on the plans.

B. Starters

1. All starters used in combination starters shall be manufactured in accordance with the latest published NEMA standards, sizes, and horsepower ratings. These starters shall be furnished with three melting alloy type thermal overload relays.

C. Overload Relays

1. Overload relays shall be of the solid state type with: phase loss, phase reversal, 3Ø overcurrent, 3Ø undercurrent, 3Ø over voltage, 3Øunder voltage and ground fault. The starter shall be inoperative if the thermal unit is removed.

D. Disconnect Handle

1. The disconnect handle used on combination starters shall always be in control of the disconnect device with the door opened or closed. The disconnect handle shall be clearly marked as to whether the disconnect device is "ON" or "OFF," and shall include a two-color handle grip, the black side visible in the "OFF" position indicating a safe condition, and the red side visible in the "ON" position indicating an unsafe or danger condition.

E. Auxiliary Contacts:

1. NEMA size 0 - 7 starters shall be equipped to incorporate an addition of at least 4, external auxiliary contacts of any arrangement, normally open or normally closed. Size 0 - 7 auxiliary contacts shall be field interchangeable.

F. Three-phase Starter requirements:

1. All magnetic starters shall be of the 3-phase, 3-pole, 60Hz, of the applicable NEMA size. Starters shall be equipped with solid state overload relays, pilot light, and momentary contact stop-start control switch, mounted in the door of the enclosure. See control diagrams for pilot and control requirements, 120VAC coil and control power transformer. Starters shall also be equipped with 2 normally open and 2 normally closed auxiliary contact, and indicating pilot light. See detailed control drawings for all pilot and control requirements.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install motor protection switches as indicated on the plans and in accordance with the CEC. Starters shall be installed in accessible areas clear from any obstruction in accordance with CEC clearance guidelines.

B. Coordinate the final selection of motor protection switches and thermal overload with motor nameplate ratings.

END OF SECTION 26 1839

SECTION 262416 - PANELBOARDS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Distribution panelboards.
2. Lighting and appliance branch-circuit panelboards.
3. Load centers.
4. Electronic-grade panelboards.

1.3 DEFINITIONS

A. ATS: Acceptance testing specification.

B. GFCI: Ground-fault circuit interrupter.

C. GFEP: Ground-fault equipment protection.

D. HID: High-intensity discharge.

E. MCCB: Molded-case circuit breaker.

F. SPD: Surge protective device.

G. VPR: Voltage protection rating.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of panelboard.

1. Include materials, switching and overcurrent protective devices, SPDs, accessories, and components indicated.
2. Include dimensions and manufacturers' technical data on features, performance, electrical characteristics, ratings, and finishes.

B. Shop Drawings: For each panelboard and related equipment.

1. Include dimensioned plans, elevations, sections, and details.
2. Show tabulations of installed devices with nameplates, conductor termination sizes, equipment features, and ratings.

3. Detail enclosure types including mounting and anchorage, environmental protection, knockouts, corner treatments, covers and doors, gaskets, hinges, and locks.

4. Detail bus configuration, current, and voltage ratings.

5. Short-circuit current rating of panelboards and overcurrent protective devices.

6. Include evidence of NRTL listing for series rating of installed devices.

7. Include evidence of NRTL listing for SPD as installed in panelboard.

8. Detail features, characteristics, ratings, and factory settings of individual overcurrent protective devices and auxiliary components.

9. Include wiring diagrams for power, signal, and control wiring.

10. Key interlock scheme drawing and sequence of operations.

11. Include time-current coordination curves for each type and rating of overcurrent protective device included in panelboards. Submit on translucent log-log graft paper; include selectable ranges for each type of overcurrent protective device. Include an Internet link for electronic access to downloadable PDF of the coordination curves.

1.5 INFORMATIONAL SUBMITTALS

A. Qualification Data: For testing agency.

B. Panelboard Schedules: For installation in panelboards.

1.6 SUBMITTALS

A. Operation and Maintenance Data: For panelboards 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. Manufacturer's written instructions for testing and adjusting overcurrent protective devices.

2. Time-current curves, including selectable ranges for each type of overcurrent protective device that allows adjustments.

1.7 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. Keys: Two spares for each type of panelboard cabinet lock.

2. Circuit Breakers Including GFCI and GFEP Types: Two spares for each panelboard.

3. Fuses for Fused Switches: Equal to 10 percent of quantity installed for each size and type, but no fewer than three of each size and type.

4. Fuses for Fused Power-Circuit Devices: Equal to 10 percent of quantity installed for each size and type, but no fewer than three of each size and type.

1.8 QUALITY ASSURANCE

A. Manufacturer Qualifications: ISO 9001 or ISO 9002 certified.

1.9 DELIVERY, STORAGE, AND HANDLING

A. Remove loose packing and flammable materials from inside panelboards; install temporary electric heating (250 W per panelboard) to prevent condensation.

B. Handle and prepare panelboards for installation according to NEMA PB 1.

1.10 FIELD CONDITIONS

A. Environmental Limitations:

1. Do not deliver or install panelboards until spaces are enclosed and weathertight, wet work in spaces is complete and dry, work above panelboards is complete, and temporary HVAC system is operating and maintaining ambient temperature and humidity conditions at occupancy levels during the remainder of the construction period.

2. Rate equipment for continuous operation under the following conditions unless otherwise indicated:

a. Ambient Temperature: Not exceeding minus 22 deg F (minus 30 deg C) to plus 104 deg F (plus 40 deg C).

b. Altitude: Not exceeding 6600 feet (2000 m).

B. Service Conditions: NEMA PB 1, usual service conditions, as follows:

1. Ambient temperatures within limits specified.

2. Altitude not exceeding 6600 feet (2000 m).

C. Interruption of Existing Electric Service: Do not interrupt electric service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary electric service according to requirements indicated:

1. Notify Architect no fewer than two days in advance of proposed interruption of electric service.

2. Do not proceed with interruption of electric service without Architect's written permission.

3. Comply with NFPA 70E.

1.11 WARRANTY

A. Manufacturer's Warranty: Manufacturer agrees to repair or replace panelboards that fail in materials or workmanship within specified warranty period.

1. Panelboard Warranty Period: 18 months from date of Substantial Completion.

B. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace SPD that fails in materials or workmanship within specified warranty period.

1. SPD Warranty Period: Five years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 PANELBOARDS COMMON REQUIREMENTS

A. Fabricate and test panelboards according to IEEE 344 to withstand seismic forces defined in Section 260548.16 "Seismic Controls for Electrical Systems."

B. Product Selection for Restricted Space: Drawings indicate maximum dimensions for panelboards including clearances between panelboards and adjacent surfaces and other items. Comply with indicated maximum dimensions.

C. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

D. Comply with NEMA PB 1.

E. Comply with NFPA 70.

F. Enclosures: Flush and Surface-mounted, dead-front cabinets.

1. Rated for environmental conditions at installed location.

a. Indoor Dry and Clean Locations: NEMA 250, Type 1

b. Outdoor Locations: NEMA 250, Type 3R

c. Kitchen or Wash-Down Areas: NEMA 250, Type 4X stainless steel

d. Other Wet or Damp Indoor Locations: NEMA 250, Type 4 Select first option in first subparagraph below for areas subject to lighter levels of contaminants and second option for areas subject to heavier levels.

e. Indoor Locations Subject to Dust, Falling Dirt, and Dripping Noncorrosive Liquids: NEMA 250, Type 12. Interior panelboards shall include door-in door covers.

2. Height: 84 inches (2.13 m) maximum.

3. Front: Secured to box with concealed trim clamps. For surface-mounted fronts, match box dimensions; for flush-mounted fronts, overlap box. Trims shall cover all live parts and shall have no exposed hardware shall be hinged cover type.

4. Hinged Front Cover: Entire front trim hinged to box and with standard door within hinged trim cover. Trims shall cover all live parts and shall have no exposed hardware.

5. Skirt for Surface-Mounted Panelboards: Same gage and finish as panelboard front with flanges for attachment to panelboard, wall, and ceiling or floor.

6. Gutter Extension and Barrier: Same gage and finish as panelboard enclosure; integral with enclosure body. Arrange to isolate individual panel sections.

7. Finishes:

   a. Panels and Trim: Steel factory finished immediately after cleaning and pretreating with manufacturer's standard two-coat, baked-on finish consisting of prime coat and thermosetting topcoat.

   b. Back Boxes: Galvanized steel.

   c. Fungus Proofing: Permanent fungicidal treatment for overcurrent protective devices and other components.

G. Incoming Mains:

1. Location: Field-Verify

2. Main Breaker: Main lug interiors up to 400 amperes shall be field convertible to main breaker.

H. Phase, Neutral, and Ground Buses:

1. Material: Hard-drawn copper, 98 percent conductivity.

   a. Plating shall run entire length of bus.

   b. Bus shall be fully rated the entire length.

2. Interiors shall be factory assembled into a unit. Replacing switching and protective devices shall not disturb adjacent units or require removing the main bus connectors.

3. Equipment Ground Bus: Adequate for feeder and branch-circuit equipment grounding conductors; bonded to box.

4. Isolated Ground Bus: Adequate for branch-circuit isolated ground conductors; insulated from box.

5. Full-Sized Neutral: Equipped with full-capacity bonding strap for service entrance applications. Mount electrically isolated from enclosure. Do not mount neutral bus in gutter.

6. Extra-Capacity Neutral Bus: Neutral bus rated 200 percent of phase bus and listed and labeled by an NRTL acceptable to authority having jurisdiction, as suitable for nonlinear loads in electronic-grade panelboards and others designated on Drawings. Connectors shall be sized for double-sized or parallel conductors as indicated on Drawings. Do not mount neutral bus in gutter.

7. Split Bus: Vertical buses divided into individual vertical sections.

I. Conductor Connectors: Suitable for use with conductor material and sizes.

1. Material: Hard-drawn copper, 98 percent conductivity.

2. Terminations shall allow use of 75 deg C rated conductors without derating.

3. Size: Lugs suitable for indicated conductor sizes, with additional gutter space, if required, for larger conductors.

4. Main and Neutral Lugs: Mechanical type, with a lug on the neutral bar for each pole in the panelboard.

5. Ground Lugs and Bus-Configured Terminators: Mechanical type, with a lug on the bar for each pole in the panelboard.

6. Feed-Through Lugs: Mechanical type, suitable for use with conductor material. Locate at opposite end of bus from incoming lugs or main device.

7. Subfeed (Double) Lugs: Mechanical type suitable for use with conductor material. Locate at same end of bus as incoming lugs or main device.

8. Gutter-Tap Lugs: Mechanical type suitable for use with conductor material and with matching insulating covers. Locate at same end of bus as incoming lugs or main device.

9. Extra-Capacity Neutral Lugs: Rated 200 percent of phase lugs mounted on extra-capacity neutral bus.

J. NRTL Label: Panelboards or load centers shall be labeled by an NRTL acceptable to authority having jurisdiction for use as service equipment with one or more main service disconnecting and overcurrent protective devices. Panelboards or load centers shall have meter enclosures, wiring, connections, and other provisions for utility metering. Coordinate with utility company for exact requirements.

K. Future Devices: Panelboards or load centers shall have mounting brackets, bus connections, filler plates, and necessary appurtenances required for future installation of devices.

1. Percentage of Future Space Capacity: 20 percent.

L. Panelboard Short-Circuit Current Rating: Rated for series-connected system with integral or remote upstream overcurrent protective devices and labeled by an NRTL. Include label or manual with size and type of allowable upstream and branch devices listed and labeled by an NRTL for series-connected short-circuit rating.

1. Panelboards rated 240 V or less shall have short-circuit ratings as shown on Drawings, but not less than 10,000 A rms symmetrical.

2. Panelboards rated above 240 V and less than 600 V shall have short-circuit ratings as shown on Drawings, but not less than 14,000 A rms symmetrical.

M. Panelboard Short-Circuit Current Rating: Fully rated to interrupt symmetrical short-circuit current available at terminals. Assembly listed by an NRTL for 100 percent interrupting capacity.

1. Panelboards and overcurrent protective devices rated 240 V or less shall have short-circuit ratings as shown on Drawings, but not less than 10,000 A rms symmetrical.

2. Panelboards and overcurrent protective devices rated above 240 V and less than 600 V shall have short-circuit ratings as shown on Drawings, but not less than 14,000 A rms symmetrical.

2.2 PERFORMANCE REQUIREMENTS

A. Seismic Performance: Panelboards 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."

B. Surge Suppression: Factory installed as an integral part of indicated panelboards, complying with UL 1449 SPD Type 2.

2.3 LIGHTING AND APPLIANCE BRANCH-CIRCUIT PANELBOARDS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Eaton.

2. General Electric Company; GE Energy Management - Electrical Distribution.

3. Siemens Industry, Inc., Energy Management Division.

4. Square D; by Schneider Electric.

B. Panelboards: NEMA PB 1; with factory-installed, integral SPD; labeled by an NRTL for compliance with UL 67 and UL 1449 after installing SPD.

C. Doors: Secured with vault-type latch with tumbler lock; keyed alike. Doors shall be door-in-door construction.

D. Main Overcurrent Protective Devices: Bolt-on thermal-magnetic circuit breakers.

E. Branch Overcurrent Protective Devices: Bolt-on thermal-magnetic circuit breakers.

F. SPD.

1. Peak Surge Current Rating: The minimum single-pulse surge current withstand rating per phase shall not be less than 100 kA. The peak surge current rating shall be the arithmetic sum of the ratings of the individual MOVs in a given mode.

2. Protection modes and UL 1449 VPR for 240/120-V, single-phase, three-wire circuits shall not exceed the following:

a. Line to Neutral: 700 V.

b. Line to Ground: 700 V.

c. Neutral to Ground: 700 V.

d. Line to Line: 1200 V.

3. SCCR: Equal to the SCCR of the panelboard in which installed.

4. I(nominal) Rating: 20 kA.

G. Buses:

1. Copper phase and neutral buses; 200 percent capacity neutral bus and lugs.

2. Copper equipment and isolated ground buses.

2.4 DISCONNECTING AND OVERCURRENT PROTECTIVE DEVICES

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Eaton.

2. General Electric Company; GE Energy Management - Electrical Distribution.

3. Siemens Industry, Inc., Energy Management Division.

4. Square D; by Schneider Electric.

B. MCCB: Comply with UL 489, with interrupting capacity to meet available fault currents.

1. Thermal-Magnetic Circuit Breakers:

a. Inverse time-current element for low-level overloads.

b. Instantaneous magnetic trip element for short circuits.

c. Adjustable magnetic trip setting for circuit-breaker frame sizes 250 A and larger.

2. Adjustable Instantaneous-Trip Circuit Breakers: Magnetic trip element with front-mounted, field-adjustable trip setting.

3. Electronic Trip Circuit Breakers:

a. RMS sensing.

b. Field-replaceable rating plug or electronic trip.

c. Digital display of settings, trip targets, and indicated metering displays.

d. Multi-button keypad to access programmable functions and monitored data.

e. Ten-event, trip-history log. Each trip event shall be recorded with type, phase, and magnitude of fault that caused the trip.

f. Integral test jack for connection to portable test set or laptop computer.

g. Field-Adjustable Settings:

1) Instantaneous trip.

2) Long- and short-time pickup levels.

3) Long and short time adjustments.

4) Ground-fault pickup level, time delay, and I squared T response.

4. Current-Limiting Circuit Breakers: Frame sizes 400 A and smaller; let-through ratings less than NEMA FU 1, RK-5.

5. GFCI Circuit Breakers: Single- and double-pole configurations with Class A ground-fault protection (6-mA trip).

6. GFEP Circuit Breakers: Class B ground-fault protection (30-mA trip).

7. Arc-Fault Circuit Interrupter Circuit Breakers: Comply with UL 1699; 120/240-V, single-pole configuration.

8. Subfeed Circuit Breakers: Vertically mounted.

9. MCCB Features and Accessories:

   a. Standard frame sizes, trip ratings, and number of poles.

   b. Breaker handle indicates tripped status.

   c. UL listed for reverse connection without restrictive line or load ratings.

   d. Lugs: Mechanical style, suitable for number, size, trip ratings, and conductor materials.

   e. Application Listing: Appropriate for application; Type SWD for switching fluorescent lighting loads; Type HID for feeding fluorescent and HID lighting circuits.

   f. Ground-Fault Protection: Integrally mounted relay and trip unit with adjustable pickup and time-delay settings, push-to-test feature, and ground-fault indicator.

   g. Communication Capability: Circuit-breaker-mounted communication module with functions and features compatible with power monitoring and control system specified in Section 260913 "Electrical Power Monitoring and Control."

   h. Shunt Trip: No Shunt Trip.

   i. Rating Plugs: Three-pole breakers with ampere ratings greater than 150 amperes shall have interchangeable rating plugs or electronic adjustable trip units.

   j. Key Interlock Kit: Externally mounted to prohibit circuit-breaker operation; key shall be removable only when circuit breaker is in off position as indicated.

   k. Zone-Selective Interlocking: Integral with electronic trip unit; for interlocking ground-fault protection function with other upstream or downstream devices.

   l. Multipole units enclosed in a single housing with a single handle or factory assembled to operate as a single unit.

m. Handle Padlocking Device: Fixed attachment, for locking circuit-breaker handle in on or off position.

n. Handle Clamp: Loose attachment, for holding circuit-breaker handle in on position.

C. Fused Switch: NEMA KS 1, Type HD; clips to accommodate specified fuses; lockable handle.

1. Fuses and Spare-Fuse Cabinet: Comply with requirements specified in Section 262813 "Fuses."

2. Fused Switch Features and Accessories:

a. Standard ampere ratings and number of poles.

b. Mechanical cover interlock with a manual interlock override, to prevent the opening of the cover when the switch is in the on position. The interlock shall prevent the switch from being turned on with the cover open. The operating handle shall have lock-off means with provisions for three padlocks.

2.5 IDENTIFICATION

A. Panelboard Label: Manufacturer's name and trademark, voltage, amperage, number of phases, and number of poles shall be located on the interior of the panelboard door.

B. Breaker Labels: Faceplate shall list current rating, UL and IEC certification standards, and AIC rating.

C. Circuit Directory: Directory card inside panelboard door, mounted in transparent card holder.

1. Circuit directory shall identify specific purpose with detail sufficient to distinguish it from all other circuits.

D. Circuit Directory: Computer-generated circuit directory mounted inside panelboard door with transparent plastic protective cover.

1. Circuit directory shall identify specific purpose with detail sufficient to distinguish it from all other circuits.

2.6 ACCESSORY COMPONENTS AND FEATURES

A. Accessory Set: Include tools and miscellaneous items required for overcurrent protective device test, inspection, maintenance, and operation.

B. Portable Test Set: For testing functions of solid-state trip devices without removing from panelboard. Include relay and meter test plugs suitable for testing panelboard meters and switchboard class relays.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verify actual conditions with field measurements prior to ordering panelboards to verify that equipment fits in allocated space in, and comply with, minimum required clearances specified in NFPA 70.

B. Receive, inspect, handle, and store panelboards according to NEMA PB 1.1.

C. Examine panelboards before installation. Reject panelboards that are damaged, rusted, or have been subjected to water saturation.

D. Examine elements and surfaces to receive panelboards for compliance with installation tolerances and other conditions affecting performance of the Work.

E. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Coordinate layout and installation of panelboards and components with other construction that penetrates walls or is supported by them, including electrical and other types of equipment, raceways, piping, encumbrances to workspace clearance requirements, and adjacent surfaces. Maintain required workspace clearances and required clearances for equipment access doors and panels.

B. Comply with NECA 1.

C. Install panelboards and accessories according to NEMA PB 1.1.

D. Equipment Mounting:

1. Install panelboards on cast-in-place concrete equipment base(s). Comply with requirements for equipment bases and foundations specified in Section 033000 "Cast-in-Place Concrete."

2. Attach panelboard to the vertical finished or structural surface behind the panelboard.

3. Comply with requirements for seismic control devices specified in Section 260548.16 "Seismic Controls for Electrical Systems."

E. Temporary Lifting Provisions: Remove temporary lifting eyes, channels, and brackets and temporary blocking of moving parts from panelboards.

F. Comply with mounting and anchoring requirements specified in Section 260548.16 "Seismic Controls for Electrical Systems."

G. Mount top of trim 90 inches (2286 mm) above finished floor unless otherwise indicated.

H. Mount panelboard cabinet plumb and rigid without distortion of box.

I. Mount recessed panelboards with fronts uniformly flush with wall finish and mating with back box.

J. Mount surface-mounted panelboards to steel slotted supports 5/8 inch (16 mm) in depth. Orient steel slotted supports vertically.

K. Install overcurrent protective devices and controllers not already factory installed.

1. Set field-adjustable, circuit-breaker trip ranges.

2. Tighten bolted connections and circuit breaker connections using calibrated torque wrench or torque screwdriver per manufacturer's written instructions.

L. Make grounding connections and bond neutral for services and separately derived systems to ground. Make connections to grounding electrodes, separate grounds for isolated ground bars, and connections to separate ground bars.

M. Install filler plates in unused spaces.

N. Stub four 1-inch (25 mm) empty conduits from panelboard into accessible ceiling space or space designated to be ceiling space in the future. Stub four 1-inch (25 mm) empty conduits into raised floor space or below slab not on grade.

O. Arrange conductors in gutters into groups and bundle and wrap with wire ties after completing load balancing.

P. Mount spare fuse cabinet in accessible location.

3.3 IDENTIFICATION

A. Identify field-installed conductors, interconnecting wiring, and components; install warning signs complying with requirements in Section 260553 "Identification for Electrical Systems."

B. Create a directory to indicate installed circuit loads after balancing panelboard loads; incorporate Owner's final room designations. Obtain approval before installing. Handwritten directories are not acceptable. Install directory inside panelboard door.

C. Panelboard Nameplates: Label each panelboard with a nameplate complying with requirements for identification specified in Section 260553 "Identification for Electrical Systems."

D. Device Nameplates: Label each branch circuit device in power panelboards with a nameplate complying with requirements for identification specified in Section 260553 "Identification for Electrical Systems."

E. Install warning signs complying with requirements in Section 260553 "Identification for Electrical Systems" identifying source of remote circuit.

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. Acceptance Testing Preparation:

1. Test insulation resistance for each panelboard bus, component, connecting supply, feeder, and control circuit.

2. Test continuity of each circuit.

D. Tests and Inspections:

1. Perform each visual and mechanical inspection and electrical test for low-voltage air circuit breakers and low-voltage surge arrestors stated in NETA ATS, Paragraph 7.6 Circuit Breakers and Paragraph 7.19.1 Surge Arrestors, Low-Voltage. Perform optional tests. Certify compliance with test parameters.

2. Correct malfunctioning units on-site, where possible, and retest to demonstrate compliance; otherwise, replace with new units and retest.

3. Perform the following infrared scan tests and inspections and prepare reports:

a. Initial Infrared Scanning: After Substantial Completion, but not more than 60 days after Final Acceptance, perform an infrared scan of each panelboard. Remove front panels so joints and connections are accessible to portable scanner.

b. Follow-up Infrared Scanning: Perform an additional follow-up infrared scan of each panelboard 11 months after date of Substantial Completion.

c. Instruments and Equipment:

1) Use an infrared scanning device designed to measure temperature or to detect significant deviations from normal values. Provide calibration record for device.

E. Panelboards will be considered defective if they do not pass tests and inspections.

F. Prepare test and inspection reports, including a certified report that identifies panelboards included and that describes scanning results, with comparisons of the two scans. Include notation of deficiencies detected, remedial action taken, and observations after remedial action.

3.5 ADJUSTING

A. Adjust moving parts and operable components to function smoothly, and lubricate as recommended by manufacturer.

B. Set field-adjustable circuit-breaker trip ranges as indicated.

C. Load Balancing: After Substantial Completion, but not more than 60 days after Final Acceptance, measure load balancing and make circuit changes. Prior to making circuit changes to achieve load balancing, inform Architect of effect on phase color coding.

1. Measure loads during period of normal facility operations.

2. Perform circuit changes to achieve load balancing outside normal facility operation schedule or at times directed by the Architect. Avoid disrupting services such as fax machines and on-line data processing, computing, transmitting, and receiving equipment.

3. After changing circuits to achieve load balancing, recheck loads during normal facility operations. Record load readings before and after changing circuits to achieve load balancing.

4. Tolerance: Maximum difference between phase loads, within a panelboard, shall not exceed 20 percent.

3.6 PROTECTION

A. Temporary Heating: Prior to energizing panelboards, apply temporary heat to maintain temperature according to manufacturer's written instructions.

END OF SECTION 262416

SECTION 262417 – DISTRIBUTION PANELBOARDS

PART I - GENERAL

1.1 SECTION INCLUDES

A. Power Distribution Panelboard - Furnish and install distribution panelboard(s) as specified herein and where shown on the associated schedules and drawings.

1.2 REFERENCES

The panelboard(s) and circuit breaker(s) referenced herein are designed and manufactured according to the latest revision of the following specifications.

A. ANSI

B. UL 489 - Molded-Case Circuit Breakers and Circuit Breaker Enclosures

C. NFPA 70 - National Electrical Code (NEC)

1.3 SUBMITTAL AND RECORD DOCUMENTATION

A. Approval documents shall include drawings. Drawings shall contain overall panelboard dimensions, interior mounting dimensions, and wiring gutter dimensions. The location of the main, branches, and solid neutral shall be clearly shown. In addition, the drawing shall illustrate one line diagrams with applicable voltage systems.

1.4 QUALIFICATIONS

A. Company specializing in manufacturing of panelboard products with a minimum of forty (40) years documented experience.

B. Panelboards shall be manufactured in accordance with standards listed Article 1.02 - REFERENCES.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Inspect and report concealed damage to carrier within their required time period.

B. Handle carefully to avoid damage to panelboard internal components, enclosure, and finish.

C. Store in a clean, dry environment. Maintain factory packaging and, if required, provide an additional heavy canvas or heavy plastic cover to protect enclosure(s) from dirt, water, construction debris, and traffic.

1.6 OPERATIONS AND MAINTENANCE MATERIALS

A. Manufacturer shall provide installation instructions and NEMA Standards Publication PB 1.1 - Instructions for Safe Installation, Operation and Maintenance of Panelboards Rated 600 Volts or Less.

1.7 WARRANTY

A. Manufacturer shall warrant specified equipment free from defects in materials and workmanship for the lesser of one (1) year from the date of installation or eighteen (18) months from the date of purchase.

PART II - PRODUCTS

2.1 MANUFACTURERS

A. Square D
B. Cutler Hammer
C. GE
D. Siemens

2.2 POWER DISTRIBUTION PANELBOARDS

A. Circuit Breaker Distribution Panelboard

1. Interior

a. Shall be type rated 600 Vac or 250 Vdc maximum. Continuous main current ratings as indicated on associated schedules and drawings not to exceed 1200 amperes maximum. Panelboard bus current ratings shall be determined by heat-rise tests conducted in accordance with UL 67.

b. Provide UL Listed short circuit current ratings (SCCR) as indicated on the associated drawings not to exceed the lowest interrupting capacity rating of any circuit breaker installed with a maximum of 200,000 RMS symmetrical amperes. Main lug and main breaker panelboards shall be suitable for use as Service Equipment when application requirements comply with UL 67 and NEC Articles 230-F and -G.

c. The panelboard interior shall have three flat bus bars stacked and aligned vertically with glass reinforced polyester insulators laminated between phases. The molded polyester insulators shall support and provide phase isolation to the entire length of bus.

d. The bussing shall be fully rated with sequentially phased branch distribution. Panelboard bussing rated 100 through 600 amperes shall be plated copper. Bussing rated 800 amperes and above shall be plated copper. Bus bar plating shall run the entire length of the bus bar. The entire interleaved assembly shall be contained between two (2) U-shaped steel channels, permanently secured to a galvanized steel mounting pan by fasteners.

e. Interior trim shall be of dead-front construction to shield user from all energized parts. Main circuit breakers through 800 amperes shall be vertically mounted. Main circuit breaker and main lug interiors shall be field convertible for top or bottom incoming feed.

f. A solidly bonded copper equipment ground bar shall be provided.

g. Solid neutral shall be equipped with a full capacity bonding strap for service entrance applications. As scheduled, UL Listed panelboards with 200% rated solid neutrals shall have plated copper neutral bus for non-linear load applications. Gutter-mounted neutral will not be acceptable.

h. Nameplates shall contain system information and catalog number or factory order number. Interior wiring diagram, neutral wiring diagram, UL Listed label, and Short Circuit Current Rating shall be displayed on the interior or in a booklet format. Leveling provisions shall be provided for flush mounted applications.

2. Group mounted circuit breakers through 1200A

a. Circuit breaker(s) shall be group mounted bolt-on

b. Circuit breakers shall be held in mounted position by bus bolts and hardware. Circuit breakers of different frame sizes shall be capable of being mounted across from each other.

c. Line-side circuit breaker connections are to be bolt-on type.

d. All unused spaces provided, unless otherwise specified, shall be fully equipped for future devices, including all appropriate connectors and mounting hardware.

(Select Electronic trip 100%, Electronic trip 80% or Thermal Magnetic)

3. Electronic trip molded case full function 100% rated circuit breakers

a. All electronic circuit breakers shall have the following time/current response adjustments: Long Time Pickup, Long Time Delay, Short Time Pickup, Short Time Delay, Ground Fault Pickup Ground Fault Delay and Instantaneous settings. Each adjustment shall have discrete settings (fully adjustable) and shall be independent of all other adjustments.

b. Circuit breaker trip system shall be a microprocessor-based true RMS sensing designed with sensing accuracy through the thirteenth (13^{th}) harmonic. Sensor ampere ratings shall be as indicated on the associated schedule and drawing.

c. Local visual trip indication for overload, short circuit and ground fault trip occurrences.

d. Long Time Pickup indication to signal when loading approaches or exceeds the adjustable ampere rating of the circuit breaker shall be provided.

e. Communications capabilities for remote monitoring of circuit breaker trip system, to include phase and ground fault currents, pre-trip alarm indication, switch settings, and trip history information shall be provided.

f. Circuit breaker shall be provided with Zone selective Interlocking (ZSI) communications capabilities on the short-time and ground fault functions compatible with all other electronic trip circuit breakers and external ground fault sensing systems as noted on schedules and drawings

g. Furnish thermal magnetic molded case circuit breakers for 250A frames and below.

4. Electronic trip molded case standard function 80% rated circuit breakers.

a. All electronic circuit breakers shall have the following time/current response adjustments: Long Time Pickup, Long Time Delay, Short Time Pickup, Short Time Delay, Ground Fault Pickup Ground Fault Delay and Instantaneous settings. Each adjustment shall have discrete settings (fully adjustable) and shall be independent of all other adjustments.

b. Circuit breaker trip system shall be a microprocessor-based true RMS sensing designed with sensing accuracy through the thirteenth (13^{th}) harmonic. Sensor ampere ratings shall be as indicated on the associated schedule and drawing.

c. Local visual trip indication for overload, short circuit and ground fault trip occurrences

d. Long Time Pickup indication to signal when loading approaches or exceeds the adjustable ampere rating of the circuit breaker shall be provided.

e. Furnish thermal magnetic molded case circuit breakers for 250A frames and below.

5. Thermal magnetic molded case circuit breakers

a. Molded case circuit breakers shall have integral thermal and instantaneous magnetic trip in each pole.

b. Circuit protective devices shall be Square D molded case circuit breakers. Circuit breakers shall be standard interrupting high interrupting extra high interrupting true current limiting. Ampere ratings shall be as shown on the drawings.

6. Enclosures

a. Type 1 Boxes

1) Boxes shall be galvanized steel constructed in accordance with UL 50 requirements. Zinc-coated galvanized steel will not be acceptable.

2) Boxes shall have removable blank end walls and interior mounting studs. Interior support bracket shall be provided for ease of interior installation.

3) Maximum enclosure dimensions shall be 44” wide and 9.5” deep.

b. Type 1 Trim Fronts

1) Trim front steel shall meet strength and rigidity requirements per UL 50 standards. Shall have an ANSI 49 medium gray enamel electrodeposited over cleaned phosphatized steel.

2) Trim front shall be 4-piece with door available in surface mount. Trim front door shall have rounded corners and edges free of burrs. A clear plastic directory cardholder shall be mounted on the inside of the door.

3) Locks shall be cylindrical tumbler type with larger enclosures requiring sliding vault locks with 3-point latching. All lock assemblies shall be keyed alike. One (1) key shall be provided with each lock.

c. Type 3R, 5, and 12

1) Enclosures shall be constructed in accordance with UL 50 requirements. Enclosures shall be painted with ANSI 49 gray enamel electrodeposited over cleaned phosphatized steel.

2) All doors shall be gasketed and be equipped with a tumbler type vault lock and two (2) additional quarter turn fasteners. A clear plastic directory cardholder shall be mounted on the inside of door. All lock assemblies shall be keyed alike. One (1) key shall be provided with each lock.

3) Maximum enclosure dimensions shall not exceed 44” wide and 14.5” deep.

7. Seismic Rating:

All distribution panelboards shall be listed and labeled.

8. Surge protection device, Class A surge protection device shall be included. See 263553.

PART III - EXECUTION

3.1 INSTALLATION

A. Install panelboards in accordance with manufacturer's written instructions, NEMA PB 1.1 and NEC standards.

B. Provide and install seismic anchoring. See 260548.

3.2 FIELD QUALITY CONTROL

A. Inspect complete installation for physical damage, proper alignment, anchorage, and grounding.

B. Measure steady state load currents at each panelboard feeder; rearrange circuits in the panelboard to balance the phase loads within 20% of each other. Maintain proper phasing for multi-wire branch circuits.

C. Check tightness of bolted connections and circuit breaker connections using calibrated torque wrench or torque screwdriver per manufacturer's written specifications.

END OF SECTION 262416

SECTION 262726 - WIRING DEVICES

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. Specification-grade receptacles, 125 V, 20 A.
2. USB receptacles.
3. GFCI receptacles, 125 V, 20 A.
4. SPD receptacles, 125 V, 20 A.
5. Hazardous (classified) location receptacles.
6. Twist-locking receptacles.
7. Pendant cord-connector devices.
8. Cord and plug sets.
9. Toggle switches, 120/277 V, 20 A.
10. Decorator-style devices, 20 A.
11. Occupancy sensors.
12. Digital timer light switches.
13. Wall-box dimmers.
14. Wall plates.
15. Floor service fittings.
16. Poke-through assemblies.
17. Prefabricated multioutlet assemblies.
18. Service poles.

1.3 DEFINITIONS

A. AFCI: Arc-fault circuit interrupter.

B. BAS: Building automation system.

C. EMI: Electromagnetic interference.

D. GFCI: Ground-fault circuit interrupter.

E. Pigtail: Short lead used to connect a device to a branch-circuit conductor.

F. RFI: Radio-frequency interference.

G. SPD: Surge protective device.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Shop Drawings: List of legends and description of materials and process used for premarking wall plates.

C. Samples: One for each type of device and wall plate specified, in each color specified.

1.5 INFORMATIONAL SUBMITTALS

A. Field quality-control reports.

1.6 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For wiring devices to include in all manufacturers' packing-label warnings and instruction manuals that include labeling conditions.

PART 2 - PRODUCTS

2.1 GENERAL WIRING-DEVICE REQUIREMENTS

A. Wiring Devices, Components, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and use.

B. Comply with NFPA 70.

C. RoHS compliant.

D. Comply with NEMA WD 1.

E. Devices that are manufactured for use with modular plug-in connectors may be substituted under the following conditions:

1. Connectors shall comply with UL 2459 and shall be made with stranding building wire.

2. Devices shall comply with requirements in this Section.

F. Devices for Owner-Furnished Equipment:

1. Receptacles: Match plug configurations.

2. Cord and Plug Sets: Match equipment requirements.

G. Device Color:

1. Wiring Devices Connected to Normal Power System: Almond Black Brown Gray Ivory White As selected by Architect. Coordinate each room with Architect. Unless otherwise indicated or required by NFPA 70 or device listing.

2. Wiring Devices Connected to Essential Electrical System: Red.

3. SPD Devices: Blue.

4. UPS Powered Receptacles: Orange.

H. Wall Plate Color: For plastic covers, match device color.

I. Source Limitations: Obtain each type of wiring device and associated wall plate from single source from single manufacturer.

2.2 SPECIFICATION-GRADE RECEPTACLES, 125 V, 20 A

A. Duplex Receptacles, 125 V, 20 A.

1. Hubble 2152

2. Leyiton 16252

3. Pass & Seymour 26252

4. Description: Two pole, three wire, and self-grounding.

5. Configuration: NEMA WD 6, Configuration 5-20R.

6. Standards: Comply with UL 498 and FS W-C-596.

7. Coordinate color for each room with Architect.

B. Weather-Resistant Duplex Receptacle, 125 V, 20 A.

1. Match indoor receptacles.

2. Description: Two pole, three wire, and self-grounding. Integral shutters that operate only when a plug is inserted in the receptacle. Square face.

3. Configuration: NEMA WD 6, Configuration 5-20R.

4. Standards: Comply with UL 498.

5. Marking: Listed and labeled as complying with NFPA 70, "Receptacles in Damp or Wet Locations" Article.

C. Tamper-Resistant Duplex and USB Charging Receptacles:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following

a. Arrow Hart, Wiring Devices; Eaton, Electrical Sector.
b. Leviton Manufacturing Co., Inc.

c. Pass & Seymour; Legrand North America, LLC.
d. Wiring Device-Kellems; Hubbell Incorporated, Commercial and Industrial.

2. Description: Single-piece, rivetless, nickel-plated, all-brass grounding system. Nickel-plated, brass mounting strap. Integral shutters that operate only when a plug is inserted in the line voltage receptacle.

3. Line Voltage Receptacles: Two pole, three wire, and self-grounding; NEMA WD 6, Configuration 5-20R.

4. USB Receptacles: Dual USB Type A, 5 V dc, and 2.1 A per receptacle (minimum).

5. Standards: Comply with UL 498, UL 1310, USB 3.0 devices, and FS W-C-596.

6. Marking: Listed and labeled as complying with NFPA 70, "Tamper-Resistant Receptacles" Article.

2.3 GFCI SPECIFICATION-GRADE RECEPTACLES, 125 V, 20 A

A. Duplex GFCI Receptacles, 125 V, 20 A:

1. Match general receptacles.

2. Description: Integral GFCI with "Test" and "Reset" buttons and LED indicator light. Two pole, three wire, and self-grounding. Coordinate color with Architect.

3. Configuration: NEMA WD 6, Configuration 5-20R.

4. Type: Feed through.

5. Standards: Comply with UL 498, UL 943 Class A, and FS W-C-596.

B. Weather-Resistant, GFCI Duplex Receptacles, 125 V, 20 A.

1. Hubble GF5252, Leviton 6599, Pass & Seymour 1591.

2. Description: Integral GFCI with "Test" and "Reset" buttons and LED indicator light. Two pole, three wire, and self-grounding. Square face. Coordinate color with Architect.

3. Configuration: NEMA WD 6, Configuration 5-15R.

4. Type: Feed through.

5. Standards: Comply with UL 498 and UL 943 Class A.

6. Marking: Listed and labeled as complying with NFPA 70, "Receptacles in Damp or Wet Locations" articles.

2.4 SPD RECEPTACLES, 125 V, 20 A

A. Duplex SPD Receptacles, 125 V, 20 A.

1. Match general receptacles.

2. Description: Two pole, three wire, and self-grounding. Integral SPD in line to ground, line to neutral, and neutral to ground. LED indicator light.

3. SPD Components: Multiple metal-oxide varistors; with a nominal clamp-level rating of 400 V and minimum single transient pulse energy dissipation of 240 J, according to IEEE C62.41.2 and IEEE C62.45.

4. Active SPD Indication: Visual and audible, with light visible in face of device to indicate device is "active" or "no longer in service."

5. Configuration: NEMA WD 6, Configuration 5-20R.

6. Standards: Comply with NEMA WD 1, UL 498, UL 1449, and FS W-C-596.

2.5 CORD AND PLUG SETS

A. Match voltage and current ratings and number of conductors to requirements of equipment being connected.

B. Cord: Rubber-insulated, stranded-copper conductors, with Type SOW-A jacket; with green-insulated grounding conductor and ampacity of at least 130 percent of the equipment rating.

C. Plug: Nylon body and integral cable-clamping jaws. Match cord and receptacle type for connection.

2.6 TOGGLE SWITCHES, 120/277 V, 20 A

A. Single-Pole Switches, 120/277 V, 20 A.

1. Hubbell 2121, Leviton 5621, Pass & Seymour 2621.

2. Description: Rectangular face, Designer Style. Coordinate design and color with Architect.

3. Standards: Comply with UL 20 and FS W-S-896.

B. Three-Way Switches, 120/277 V, 20 A.

1. Hubbell 2121, Leviton 5621, Pass & Seymour 2621.

2. Description: Rectangular face, Designer Style. Coordinate design and color with Architect.

3. Standards: Comply with UL 20 and FS W-S-896.

C. Four-Way Switches, 120/277 V, 20 A.

1. Hubbell 2121, Leviton 5621, Pass & Seymour 2621.

2. Description: Rectangular face, Designer Style. Coordinate design and color with Architect.

3. Standards: Comply with UL 20 and FS W-S-896.

D. Pilot-Light, Three-way Switches: 120/277 V, 20 .

1. Manufacturers: Match general switches.

2. Description: Illuminated when switch is on.

3. Standards: Comply with UL 20 and FS W-S-896.

E. Lighted Single-Pole Switches, 120/277 V, 20 A.

1. Manufacturers: Match general switches.

2. Description: Handle illuminated when switch is on.

3. Standards: Comply with NEMA WD 1, UL 20, and FS W-S-896.

F. Key-Operated, Single-Pole Switches, 120/277 V, 20 A.

1. Hubbell HBL1221, Leviton 122-2IL, Pass & Seymour 20ACI-L.

2. Description: Factory-supplied key in lieu of switch handle. Coordinate design with Architect.

3. Standards: Comply with UL 20 and FS W-S-896.

G. Single-Pole, Double-Throw, Momentary-Contact, Center-off Switches, 120/277 V, 20 A

1. Leviton 5657-2.

2. Description: For use with mechanically held lighting contactors. Single pole AC quiet commercial specification grade self- grading back & side wined. Coordinate design and color with Architect.

3. Standards: Comply with NEMA WD 1, UL 20, and FS W-S-896.

2.7 DECORATOR-STYLE DEVICES, 20 A

A. Decorator Duplex Receptacles, 125 V, 20 A.

1. Manufacturers: Leviton, Hubbell, Pass & Seymour.

2. Description: Two pole, three wire, and self-grounding. Square face.

3. Configuration: NEMA WD 6, Configuration 5-20R.

4. Standards: Comply with UL 498.

B. Decorator Tamper-Resistant Duplex Receptacles, 125 V, 20 A

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Arrow Hart, Wiring Devices; Eaton, Electrical Sector.
b. Leviton Manufacturing Co., Inc.

c. Pass & Seymour; Legrand North America, LLC.
d. Wiring Device-Kellems; Hubbell Incorporated, Commercial and Industrial.

2. Description: Two pole, three wire, and self-grounding. Integral shutters that operate only when a plug is inserted in the receptacle. Square face.

3. Configuration: NEMA WD 6, Configuration 5-20R.

4. Standards: Comply with UL 498.

5. Marking: Listed and labeled as complying with NFPA 70, "Tamper-Resistant Receptacles" Article.

C. Decorator, Tamper- and Weather-Resistant, Duplex Receptacles, 125 V, 20 A

1. Manufacturers: Leviton, Hubbell, Pass & Seymour.

2. Description: Two pole, three wire, and self-grounding. Integral shutters that operate only when a plug is inserted in the receptacle. Square face.

3. Configuration: NEMA WD 6, Configuration 5-20R.

4. Standards: Comply with UL 498.

5. Marking: Listed and labeled as complying with NFPA 70, "Tamper-Resistant Receptacles" and "Receptacles in Damp or Wet Locations" articles.

D. Decorator Single-Pole Switches, 120/277 V, 20 A

1. Manufacturers: Leviton, Hubbell, Pass & Seymour.

2. Comply with UL 20.

E. Decorator Single-Pole Lighted Switches,120/277 V, 20 A

1. Manufacturers: Leviton, Hubbell, Pass & Seymour.

2. Description: Square face illuminated when circuit is switched off.

3. Standards: Comply with UL 20.

2.8 OCCUPANCY SENSORS

A. Wall Switch Sensor Light Switch, Dual Technology

1. Manufacturer: Unenco, Leviton, Wattstopper, Hubbell.

2. Description: Switchbox-mounted, combination lighting-control sensor and conventional switch lighting-control unit using dual (ultrasonic and passive infrared) technology.

3. Standards: Comply with UL 20.

4. Rated 960 W at 120 V ac for tungsten lighting, 10 A at 120 V ac or 10 A at 277 V ac for fluorescent or LED lighting, and 1/4 hp at 120 V ac.

5. Adjustable time delay of 20 minutes.
6. Able to be locked to Automatic or Manual-On mode.
7. Automatic Light-Level Sensor: Adjustable from 2 to 200 fc (21.5 to 2152 lux).
8. Connections: Provisions for connection to BAS.
9. Connections: RJ-45 communications outlet.
10. Connections: Integral wireless networking.

B. Wall Sensor Light Switch, Passive Infrared

1. Unenco IWS-ZP-120, Leviton ODS10-10, Wattstopper WT-100-W.
2. Description: Switchbox-mounted, combination, lighting-control sensor and conventional switch lighting-control unit using passive infrared technology.
3. Standards: Comply with UL 20.
4. Connections: Provisions for connection to BAS.
5. Connections: Hard wired.
6. Rated 800 W at 120 V ac for tungsten lighting, 10 A at 120 V ac or 10 A at 277 V ac for fluorescent or LED lighting, and 1/4 hp at 120 V a c for motor.
7. Integral relay for connection to BAS.
8. Adjustable time delay of up to 30 minutes.
9. Able to be locked to Manual - On mode.
10. Automatic Light-Level Sensor: Adjustable from 2 to 200 fc (21.5 to 2152 lux).

C. Wall Sensor Light Switch, Ultrasonic

1. Tork 5C20 with TRPI relay, Unenco C-500-800 with 211-QTI relay, Watt Stopper W-500A with A120EP relay.
2. Description: Ceiling-mounted, combination, lighting-control sensor and conventional switch lighting-control unit using ultrasonic technology.
3. Standards: Comply with UL 20.
4. Connections: Provisions for connection to BAS.
5. Rated 800 W at 120 V ac for tungsten lighting, 10 A at 120 V ac or 10 A at 277 V ac for fluorescent or LED lighting, and 1/4 hp at 120 V ac for motor.
6. Integral relay for connection to BAS.
7. Adjustable time delay of up to 30 minutes.

8. Able to be locked to Manual - On mode.

9. Automatic Light-Level Sensor: Adjustable from 2 to 200 fc (21.5 to 2152 lux).

2.9 TIMER LIGHT SWITCH

A. Digital Timer Light Switch

1. Manufacturers: Hubbel, Leviton, Pass & Seymour.

2. Description: Switchbox-mounted, combination digital timer and conventional switch lighting-control unit, with backlit digital display, with selectable time interval in 10-minute increments.

3. Standards: Comply with UL 20.

4. Rated 800 W at 120 V ac for tungsten lighting, 10 A at 120 V ac or 10 A at 277 V ac for fluorescent or LED lighting, and 1/4 hp at 120 V ac for motor.

5. Integral relay for connection to BAS.

B. Fan-Speed Controls

1. Approved manufacturer and Model: W-1411 by Casablanca Pomona, CA (909) 629-0958.

2. Description: Coordinate design and color with Architect.

3. Standards: Comply with UL 1917.

2.10 TV WALL JACKS

1. Approved manufacturers and models: Hubble CX 11, CFPMA-I & Leviton 40681-I.

2. Description: Type F TU wall jack. Coordinate design and color with Architect.

2.11 DIMMERS

A. Wall-Box Dimmers:

1. Hubbell, Levtion, Pass & Seymour.

2. Description: Modular, full-wave, solid-state dimmer switch with integral, quiet on-off switches, with audible frequency and EMI/RFI suppression filters.

3. Control: Continuously adjustable slider; with single-pole or three-way switching.

4. Standards: Comply with UL 1472.

5. Incandescent Lamp Dimmers: 120 V; control shall follow square-law dimming curve. On-off switch positions shall bypass dimmer module.

a. 600 W; dimmers shall require no derating when ganged with other devicesRetain "Fluorescent Lamp Dimmer Switches" Subparagraph below with compatible

dimming-type ballasts. Coordinate with Section 265116 "Fluorescent Interior Lighting" or Section 265119 "LED Interior Lighting." Use lamp and ballast, if applicable, types to obtain consistent dimming characteristics.

6. LED Lamp Dimmer Switches: Modular; compatible with LED lamps; trim potentiometer to adjust low-end dimming; capable of consistent dimming with low end not greater than 20 percent of full brightness. Fully off in the OFF position.

2.12 WALL PLATES

A. Single Source: Obtain wall plates from same manufacturer of wiring devices.

B. Single and combination types shall match corresponding wiring devices.

1. Plate-Securing Screws: Metal with head color to match plate finish.

2. Material for Finished Spaces: Coordinate plate color with Architect. Nylon.

3. Material for Unfinished Spaces: Smooth, High Impact Nylon. Coordinate color with Architect and match wiring device.

4. Material for Damp Locations: Cast aluminum with spring-loaded lift cover, and listed and labeled for use in wet and damp locations. Coordinate cover style with Architect.

C. Wet-Location, Weatherproof Cover Plates: NEMA 250, complying with Type 3R, weather-resistant with lockable cover, weather proof mats, and corrosion resistant metal plate. Coordinate design L style with Architect.

1. Approved Manufacturer models:

a. Hubbell CWP26H, horizontal; WP26, vertical.

b. Leviton 4990, horizontal; 4992, vertical.

c. Pass & Seymour WPH26, horizontal; WP26, vertical.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Comply with NECA 1, including mounting heights listed in that standard, unless otherwise indicated.

B. Coordination with Other Trades:

1. Protect installed devices and their boxes. Do not place wall finish materials over device boxes, and do not cut holes for boxes with routers that are guided by riding against outside of boxes.

2. Keep outlet boxes free of plaster, drywall joint compound, mortar, cement, concrete, dust, paint, and other material that may contaminate the raceway system, conductors, and cables.

3. Install device boxes in brick or block walls so that the cover plate does not cross a joint unless the joint is troweled flush with the face of the wall.

4. Install wiring devices after all wall preparation, including painting, is complete.

C. Conductors:

1. Do not strip insulation from conductors until right before they are spliced or terminated on devices.

2. Strip insulation evenly around the conductor using tools designed for the purpose. Avoid scoring or nicking of solid wire or cutting strands from stranded wire.

3. The length of free conductors at outlets for devices shall comply with NFPA 70, Article 300, without pigtails.

4. Existing Conductors:

a. Cut back and pigtail, or replace all damaged conductors.

b. Straighten conductors that remain and remove corrosion and foreign matter.

c. Pigtailing existing conductors is permitted, provided the outlet box is large enough.

D. Device Installation:

1. Replace devices that have been in temporary use during construction and that were installed before building finishing operations were complete.

2. Keep each wiring device in its package or otherwise protected until it is time to connect conductors.

3. Do not remove surface protection, such as plastic film and smudge covers, until the last possible moment.

4. Connect devices to branch circuits using pigtails that are not less than 6 inches (152 mm) in length.

5. When there is a choice, use side wiring with binding-head screw terminals. Wrap solid conductor tightly clockwise, two-thirds to three-fourths of the way around terminal screw.

6. Use a torque screwdriver when a torque is recommended or required by manufacturer.

7. When conductors larger than No. 12 AWG are installed on 15- or 20-A circuits, splice No. 12 AWG pigtails for device connections.

8. Tighten unused terminal screws on the device.

9. When mounting into metal boxes, remove the fiber or plastic washers used to hold device-mounting screws in yokes, allowing metal-to-metal contact.

E. Receptacle Orientation:

1. Install ground pin of vertically mounted receptacles down, and on horizontally mounted receptacles to the right.

2. Install hospital-grade receptacles in patient-care areas with the ground pin or neutral blade at the top.

F. Device Plates: Do not use oversized or extra-deep plates. Repair wall finishes and remount outlet boxes when standard device plates do not fit flush or do not cover rough wall opening.

G. Dimmers:

1. Install dimmers within terms of their listing.

2. Verify that dimmers used for fan-speed control are listed for that application.

3. Install unshared neutral conductors on line and load side of dimmers according to manufacturers' device, listing conditions in the written instructions.

H. Arrangement of Devices: Unless otherwise indicated, mount flush, with long dimension vertical and with grounding terminal of receptacles on top. Group adjacent switches under single, multigang wall plates.

I. Adjust locations of floor service outlets and service poles to suit arrangement of partitions and furnishings.

3.2 GFCI RECEPTACLES

A. Install non-feed-through GFCI receptacles where protection of downstream receptacles is not required.

3.3 IDENTIFICATION

A. Comply with Section 260553 "Identification for Electrical Systems."

B. Identify each receptacle with panelboard identification and circuit number. Use hot, stamped, or engraved machine printing with black-filled lettering on face of plate, and durable wire markers or tags inside outlet boxes.

C. Essential Electrical System: Mark receptacles supplied from the essential electrical system to allow easy identification using a self-adhesive label.

3.4 FIELD QUALITY CONTROL

A. Test Instruments: Use instruments that comply with UL 1436.

B. Test Instrument for Receptacles: Digital wiring analyzer with digital readout or illuminated digital-display indicators of measurement.

C. Perform the following tests and inspections.

1. Test Instruments: Use instruments that comply with UL 1436.

2. Test Instrument for Receptacles: Digital wiring analyzer with digital readout or illuminated digital-display indicators of measurement.

D. Tests for Receptacles:

1. Line Voltage: Acceptable range is 116 to 124 V.

2. Percent Voltage Drop under 15-A Load: A value of 3 percent or higher is unacceptable.

3. Ground Impedance: Values of up to 2 ohms are acceptable.

4. GFCI Trip: Test for tripping values specified in UL 1436 and UL 943.

5. Using the test plug, verify that the device and its outlet box are securely mounted.

6. Tests shall be diagnostic, indicating damaged conductors, high resistance at the circuit breaker, poor connections, inadequate fault-current path, defective devices, or similar problems. Correct circuit conditions, remove malfunctioning units and replace with new ones, and retest as specified above.

E. Wiring device will be considered defective if it does not pass tests and inspections.

F. Prepare test and inspection reports.

END OF SECTION 262726

SECTION 262816 - ENCLOSED SWITCHES AND CIRCUIT BREAKERS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Fusible switches.
2. Nonfusible switches.
3. Receptacle switches.
4. Shunt trip switches.
5. Molded-case circuit breakers (MCCBs).
6. Molded-case switches.
7. Enclosures.

1.3 DEFINITIONS

A. NC: Normally closed.

B. NO: Normally open.

C. SPDT: Single pole, double throw.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of enclosed switch, circuit breaker, accessory, and component indicated. Include nameplate ratings, dimensioned elevations, sections, weights, and manufacturers' technical data on features, performance, electrical characteristics, ratings, accessories, and finishes.

1. Enclosure types and details for types other than NEMA 250, Type 1.
2. Current and voltage ratings.
3. Short-circuit current ratings (interrupting and withstand, as appropriate).
4. Include evidence of a nationally recognized testing laboratory (NRTL) listing for series rating of installed devices.
5. Detail features, characteristics, ratings, and factory settings of individual overcurrent protective devices, accessories, and auxiliary components.

6. Include time-current coordination curves (average melt) for each type and rating of overcurrent protective device; include selectable ranges for each type of overcurrent protective device. Provide in PDF electronic format.

B. Shop Drawings: For enclosed switches and circuit breakers.

1. Include plans, elevations, sections, details, and attachments to other work.

2. Include wiring diagrams for power, signal, and control wiring.

1.5 INFORMATIONAL SUBMITTALS

A. Qualification Data: For qualified testing agency.

B. Seismic Qualification Data: Certificates, for enclosed switches and circuit breakers, accessories, and components, from manufacturer.

1. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.

2. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.

3. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.

C. Field quality-control reports.

1.6 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For enclosed switches and circuit breakers to include in emergency, operation, and maintenance manuals.

1. In addition to items specified in Section 017823 "Operation and Maintenance Data," include the following:

a. Manufacturer's written instructions for testing and adjusting enclosed switches and circuit breakers.

b. Time-current coordination curves (average melt) for each type and rating of overcurrent protective device; include selectable ranges for each type of overcurrent protective device. Provide in PDF electronic format.

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. Fuses: Equal to 10 percent of quantity installed for each size and type, but no fewer than three of each size and type.

2. Fuse Pullers: Two.

1.8 QUALITY ASSURANCE

A. Testing Agency Qualifications: Accredited by NETA.

1. Testing Agency's Field Supervisor: Currently certified by NETA to supervise on-site testing.

1.9 FIELD CONDITIONS

A. Environmental Limitations: Rate equipment for continuous operation under the following conditions unless otherwise indicated:

1. Ambient Temperature: Not less than minus 22 deg F (minus 30 deg C) and not exceeding 104 deg F (40 deg C).

2. Altitude: Not exceeding 6600 feet (2010 m).

1.10 WARRANTY

A. Manufacturer's Warranty: Manufacturer and Installer agree to repair or replace components that fail in materials or workmanship within specified warranty period.

1. Warranty Period: One year(s) from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Seismic Performance: Enclosed switches and circuit breakers shall withstand the effects of earthquake motions determined according to ASCE/SEI 7.

1. The term "withstand" means "the unit will remain in place without separation of any parts from the device when subjected to the seismic forces specified and the unit will be fully operational after the seismic event."

2.2 GENERAL REQUIREMENTS

A. Source Limitations: Obtain enclosed switches and circuit breakers, overcurrent protective devices, components, and accessories, within same product category, from single manufacturer.

B. Product Selection for Restricted Space: Drawings indicate maximum dimensions for enclosed switches and circuit breakers, including clearances between enclosures, and adjacent surfaces and other items. Comply with indicated maximum dimensions.

C. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by an NRTL, and marked for intended location and application.

D. Comply with NFPA 70.

2.3 FUSIBLE SWITCHES

A. Fuses: Bassman, Edison Fusegear, GEC Alsthom, Littel fuse.

B. Switches: Same as manufacturer of project’s main panel board.

C. Type HD, Heavy Duty:

1. Single throw.
2. Two pole.
3. 250-V ac.
4. 1200 A and smaller
5. UL 98 and NEMA KS 1, horsepower rated, with clips or bolt pads to accommodate indicated fuses.
6. Lockable handle with capability to accept three padlocks, and interlocked with cover in closed position.

D. Accessories:

1. Equipment Ground Kit: Internally mounted and labeled for copper and aluminum ground conductors.
2. Neutral Kit: Internally mounted; insulated, capable of being grounded and bonded; labeled for copper and aluminum neutral conductors.
3. Isolated Ground Kit: Internally mounted; insulated, labeled for copper and aluminum neutral conductors.
4. Class R Fuse Kit: Provides rejection of other fuse types when Class R fuses are specified.
5. Hookstick Handle: Allows use of a hookstick to operate the handle.
6. Lugs: Mechanical type, suitable for number, size, and conductor material.
7. Service-Rated Switches: Labeled for use as service equipment.

2.4 NONFUSIBLE SWITCHES

A. Same as manufacturer of Project’s main panel board.

B. Accessories:

1. Equipment Ground Kit: Internally mounted and labeled for copper and aluminum ground conductors.
2. Neutral Kit: Internally mounted; insulated, capable of being grounded and bonded; labeled for copper and aluminum neutral conductors.
3. Isolated Ground Kit: Internally mounted; insulated, labeled for copper and aluminum neutral conductors.
4. Class R Fuse Kit: Provides rejection of other fuse types when Class R fuses are specified.
5. Hookstick Handle: Allows use of a hookstick to operate the handle.

6. Lugs: Mechanical type, suitable for number, size, and conductor material.

7. Service-Rated Switches: Labeled for use as service equipment.

2.5 SHUNT TRIP SWITCHES

A. Bussman, Square D, Eaton, GE, Siemens.

B. General Requirements: Comply with ASME A17.1, UL 50, and UL 98, with Class J fuse block and 200-kA interrupting and short-circuit current rating.

C. Type HD, Heavy-Duty, Two Pole, Single-Throw Fusible Switch: 250-V ac, Amperage as incidated. A; UL 98 and NEMA KS 1; integral shunt trip mechanism; horsepower rated, with clips or bolt pads to accommodate indicated fuses; lockable handle with capability to accept three padlocks; interlocked with cover in closed position.

D. Control Circuit: 120-V ac; obtained from integral control power transformer, with primary and secondary fuses, with a control power transformer source of enough capacity to operate shunt trip, pilot, indicating and control devices.

E. Accessories:

1. Oiltight key switch for key-to-test function.

2. Oiltight red ON pilot light.

3. Isolated neutral lug; 100 percent rating.

4. Mechanically interlocked auxiliary contacts that change state when switch is opened and closed.

5. Form C alarm contacts that change state when switch is tripped.

6. Three-pole, double-throw, fire-safety and alarm relay 24-V dc coil voltage.

7. Three-pole, double-throw, fire-alarm voltage monitoring relay complying with NFPA 72.

8. Neutral Kit: Internally mounted; insulated, capable of being grounded and bonded; labeled for copper and aluminum neutral conductors.

9. Isolated Ground Kit: Internally mounted; insulated, labeled for copper and aluminum neutral conductors.

10. Class R Fuse Kit: Provides rejection of other fuse types when Class R fuses are specified.

11. Auxiliary Contact Kit: Two NO/NC (Form "C") auxiliary contact(s), arranged to activate before switch blades open. Contact rating 120-V ac.

12. Hookstick Handle: Allows use of a hookstick to operate the handle.

13. Lugs: Mechanical type, suitable for number, size, and conductor material.

14. Service-Rated Switches: Labeled for use as service equipment.

2.6 MOLDED-CASE CIRCUIT BREAKERS

A. Same manufacturer as breakers in main panel board.

B. Circuit breakers shall be constructed using glass-reinforced insulating material. Current carrying components shall be completely isolated from the handle and the accessory mounting area.

C. Circuit breakers shall have a toggle operating mechanism with common tripping of all poles, which provides quick-make, quick-break contact action. The circuit-breaker handle shall be over center, be trip free, and reside in a tripped position between on and off to provide local trip indication. Circuit-breaker escutcheon shall be clearly marked on and off in addition to providing international I/O markings. Equip circuit breaker with a push-to-trip button, located on the face of the circuit breaker to mechanically operate the circuit-breaker tripping mechanism for maintenance and testing purposes.

D. The maximum ampere rating and UL, IEC, or other certification standards with applicable voltage systems and corresponding interrupting ratings shall be clearly marked on face of circuit breaker. Circuit breakers shall be 100 percent rated.

E. MCCBs shall be equipped with a device for locking in the isolated position.

F. Lugs shall be suitable for the 167 deg F (75 deg C) temperature rating in NFPA 70.

G. Standard: Comply with UL 489 with interrupting capacity to comply with available fault currents.

H. Thermal-Magnetic Circuit Breakers: Inverse time-current thermal element for low-level overloads and instantaneous magnetic trip element for short circuits. Adjustable magnetic trip setting for circuit-breaker frame sizes 250 A and larger.

I. Adjustable, Instantaneous-Trip Circuit Breakers: Magnetic trip element with front-mounted, field-adjustable trip setting.

J. Electronic Trip Circuit Breakers: Field-replaceable rating plug, rms sensing, with the following field-adjustable settings:

1. Instantaneous trip.

2. Long- and short-time pickup levels.

3. Long- and short-time time adjustments.

4. Ground-fault pickup level, time delay, and I-squared t response.

K. Current-Limiting Circuit Breakers: Frame sizes 400 A and smaller, and let-through ratings less than NEMA FU 1, RK-5.

L. Integrally Fused Circuit Breakers: Thermal-magnetic trip element with integral limiter-style fuse listed for use with circuit breaker and trip activation on fuse opening or on opening of fuse compartment door.

M. Ground-Fault Circuit-Interrupter (GFCI) Circuit Breakers: Single- and two-pole configurations with Class A ground-fault protection (6-mA trip).

N. Ground-Fault Equipment-Protection (GFEP) Circuit Breakers: With Class B ground-fault protection (30-mA trip).

O. Features and Accessories:

1. Standard frame sizes, trip ratings, and number of poles.

2. Lugs: Mechanical type, suitable for number, size, trip ratings, and conductor material.

3. Application Listing: Appropriate for application; Type SWD for switching fluorescent lighting loads; Type HID for feeding fluorescent and high-intensity discharge lighting circuits.

4. Ground-Fault Protection: Comply with UL 1053; integrally mounted, self-powered type with mechanical ground-fault indicator; relay with adjustable pickup and time-delay settings, push-to-test feature, internal memory, and shunt trip unit; and three-phase, zero-sequence current transformer/sensor.

2.7 MOLDED-CASE SWITCHES

A. Same manufacturer as panel boards.

B. Description: MCCB with fixed, high-set instantaneous trip only, and short-circuit withstand rating equal to equivalent breaker frame size interrupting rating.

C. Standard: Comply with UL 489 with interrupting capacity to comply with available fault currents.

D. Features and Accessories:

1. Standard frame sizes and number of poles.

2. Lugs:

a. Mechanical type, suitable for number, size, trip ratings, and conductor material.

b. Lugs shall be suitable for the 167 deg F (75 deg C) temperature rating in NFPA 70.

3. Ground-Fault Protection: Comply with UL 1053; remote-mounted and powered type with mechanical ground-fault indicator; relay with adjustable pickup and time-delay settings, push-to-test feature, internal memory, and shunt trip unit; and three-phase, zero-sequence current transformer/sensor.

2.8 ENCLOSURES

A. Enclosed Switches and Circuit Breakers: UL 489, NEMA KS 1, NEMA 250, and UL 50, to comply with environmental conditions at installed location.

B. Enclosure Finish: The enclosure shall be finished with gray baked enamel paint, electrodeposited on cleaned, phosphatized steel (NEMA 250 Type 1) indoor gray baked enamel paint, electrodeposited on cleaned, phosphatized galvanized steel (NEMA 250 Types 3R, 12) outdoor.

C. Conduit Entry: NEMA 250 Types 4, 4X, and 12 enclosures shall contain no knockouts. NEMA 250 Types 7 and 9 enclosures shall be provided with threaded conduit openings in both endwalls.

D. Operating Mechanism: The circuit-breaker operating handle shall directly operable through the front cover of the enclosure (NEMA 250 Type 1) directly operable through the dead front trim of the enclosure (NEMA 250 Type 3R). The cover interlock mechanism shall have an externally operated override. The override shall not permanently disable the interlock mechanism, which shall return to the locked position once the override is released. The tool used to override the cover interlock mechanism shall not be required to enter the enclosure in order to override the interlock.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine elements and surfaces to receive enclosed switches and circuit breakers for compliance with installation tolerances and other conditions affecting performance of the Work.

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

1. Commencement of work shall indicate Installer's acceptance of the areas and conditions as satisfactory.

3.2 PREPARATION

A. Interruption of Existing Electric Service: Do not interrupt electric service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary electric service according to requirements indicated:

1. Notify Architect no fewer than seven days in advance of proposed interruption of electric service.

2. Indicate method of providing temporary electric service.

3. Do not proceed with interruption of electric service without Architect's written permission.

4. Comply with NFPA 70E.

3.3 ENCLOSURE ENVIRONMENTAL RATING APPLICATIONS

A. Enclosed Switches and Circuit Breakers: Provide enclosures at installed locations with the following environmental ratings.

1. Indoor, Dry and Clean Locations: NEMA 250, Type 1.

2. Outdoor Locations: NEMA 250, Type 3R.

3. Kitchen Areas: NEMA 250, Type 4X stainless steel.

4. Other Wet or Damp, Indoor Locations: NEMA 250, Type 4.

5. Indoor Locations Subject to Dust, Falling Dirt, and Dripping Noncorrosive Liquids: NEMA 250, Type 12.

6. Hazardous Areas Indicated on Drawings: NEMA 250, Type 7.

B. Coordinate layout and installation of switches, circuit breakers, and components with equipment served and adjacent surfaces. Maintain required workspace clearances and required clearances for equipment access doors and panels.

C. Install individual wall-mounted switches and circuit breakers with tops at uniform height unless otherwise indicated.

D. Comply with mounting and anchoring requirements specified in Section 260548.16 "Seismic Controls for Electrical Systems."

E. Temporary Lifting Provisions: Remove temporary lifting of eyes, channels, and brackets and temporary blocking of moving parts from enclosures and components.

F. Install fuses in fusible devices.

G. Comply with NFPA 70 and NECA 1.

3.4 IDENTIFICATION

A. Comply with requirements in Section 260553 "Identification for Electrical Systems."

1. Identify field-installed conductors, interconnecting wiring, and components; provide warning signs.

2. Label each enclosure with engraved metal or laminated-plastic nameplate.

3.5 FIELD QUALITY CONTROL

A. Perform tests and inspections.

B. Tests and Inspections for Switches:

1. Visual and Mechanical Inspection:

a. Inspect physical and mechanical condition.

b. Inspect anchorage, alignment, grounding, and clearances.

c. Verify that the unit is clean.

d. Verify blade alignment, blade penetration, travel stops, and mechanical operation.

e. Verify that fuse sizes and types match the Specifications and Drawings.

f. Verify that each fuse has adequate mechanical support and contact integrity.

g. Inspect bolted electrical connections for high resistance using one of the two following methods:

1) Use a low-resistance ohmmeter.

a) Compare bolted connection resistance values to values of similar connections. Investigate values that deviate from those of similar bolted connections by more than 50 percent of the lowest value.

2) Verify tightness of accessible bolted electrical connections by calibrated torque-wrench method in accordance with manufacturer's published data or NETA ATS Table 100.12.

a) Bolt-torque levels shall be in accordance with manufacturer's published data. In the absence of manufacturer's published data, use NETA ATS Table 100.12.

h. Verify that operation and sequencing of interlocking systems is as described in the Specifications and shown on the Drawings.

i. Verify correct phase barrier installation.

j. Verify lubrication of moving current-carrying parts and moving and sliding surfaces.

2. Electrical Tests:

a. Perform resistance measurements through bolted connections with a low-resistance ohmmeter. Compare bolted connection resistance values to values of similar connections. Investigate values that deviate from adjacent poles or similar switches by more than 50 percent of the lowest value.

b. Measure contact resistance across each switchblade fuseholder. Drop values shall not exceed the high level of the manufacturer's published data. If manufacturer's published data are not available, investigate values that deviate from adjacent poles or similar switches by more than 50 percent of the lowest value.

c. Perform insulation-resistance tests for one minute on each pole, phase-to-phase and phase-to-ground with switch closed, and across each open pole. Apply voltage in accordance with manufacturer's published data. In the absence of manufacturer's published data, use Table 100.1 from the NETA ATS. Investigate values of insulation resistance less than those published in Table 100.1 or as recommended in manufacturer's published data.

d. Measure fuse resistance. Investigate fuse-resistance values that deviate from each other by more than 15 percent.

e. Perform ground fault test according to NETA ATS 7.14 "Ground Fault Protection Systems, Low-Voltage."

C. Tests and Inspections for Molded Case Circuit Breakers:

1. Visual and Mechanical Inspection:

a. Verify that equipment nameplate data are as described in the Specifications and shown on the Drawings.

b. Inspect physical and mechanical condition.

c. Inspect anchorage, alignment, grounding, and clearances.

d. Verify that the unit is clean.

e. Operate the circuit breaker to ensure smooth operation.

f. Inspect bolted electrical connections for high resistance using one of the two following methods:

1) Use a low-resistance ohmmeter.

a) Compare bolted connection resistance values to values of similar connections. Investigate values that deviate from those of similar bolted connections by more than 50 percent of the lowest value.

2) Verify tightness of accessible bolted electrical connections by calibrated torque-wrench method in accordance with manufacturer's published data or NETA ATS Table 100.12.

a) Bolt-torque levels shall be in accordance with manufacturer's published data. In the absence of manufacturer's published data, use NETA ATS Table 100.12.

g. Inspect operating mechanism, contacts, and chutes in unsealed units.

h. Perform adjustments for final protective device settings in accordance with the coordination study.

2. Electrical Tests:

a. Perform resistance measurements through bolted connections with a low-resistance ohmmeter. Compare bolted connection resistance values to values of similar connections. Investigate values that deviate from adjacent poles or similar switches by more than 50 percent of the lowest value.

b. Perform insulation-resistance tests for one minute on each pole, phase-to-phase and phase-to-ground with circuit breaker closed, and across each open pole. Apply voltage in accordance with manufacturer's published data. In the absence of manufacturer's published data, use Table 100.1 from the NETA ATS. Investigate values of insulation resistance less than those published in Table 100.1 or as recommended in manufacturer's published data.

c. Perform a contact/pole resistance test. Drop values shall not exceed the high level of the manufacturer's published data. If manufacturer's published data are not available, investigate values that deviate from adjacent poles or similar switches by more than 50 percent of the lowest value.

d. Perform insulation resistance tests on all control wiring with respect to ground. Applied potential shall be 500-V dc for 300-V rated cable and 1000-V dc for 600-V rated cable. Test duration shall be one minute. For units with solid state

components, follow manufacturer's recommendation. Insulation resistance values shall be no less than two megohms.

e. Determine the following by primary current injection:

1) Long-time pickup and delay. Pickup values shall be as specified. Trip characteristics shall not exceed manufacturer's published time-current characteristic tolerance band, including adjustment factors.

2) Short-time pickup and delay. Short-time pickup values shall be as specified. Trip characteristics shall not exceed manufacturer's published time-current characteristic tolerance band, including adjustment factors.

3) Ground-fault pickup and time delay. Ground-fault pickup values shall be as specified. Trip characteristics shall not exceed manufacturer's published time-current characteristic tolerance band, including adjustment factors.

4) Instantaneous pickup. Instantaneous pickup values shall be as specified and within manufacturer's published tolerances.

f. Test functionality of the trip unit by means of primary current injection. Pickup values and trip characteristics shall be as specified and within manufacturer's published tolerances.

g. Perform minimum pickup voltage tests on shunt trip and close coils in accordance with manufacturer's published data. Minimum pickup voltage of the shunt trip and close coils shall be as indicated by manufacturer.

h. Verify correct operation of auxiliary features such as trip and pickup indicators; zone interlocking; electrical close and trip operation; trip-free, anti-pump function; and trip unit battery condition. Reset all trip logs and indicators. Investigate units that do not function as designed.

i. Verify operation of charging mechanism. Investigate units that do not function as designed.

3. Correct malfunctioning units on-site, where possible, and retest to demonstrate compliance; otherwise, replace with new units and retest.

4. Perform the following infrared scan tests and inspections and prepare reports:

a. Initial Infrared Scanning: After Substantial Completion, but not more than 60 days after Final Acceptance, perform an infrared scan of each enclosed switch and circuit breaker. Remove front panels so joints and connections are accessible to portable scanner.

b. Follow-up Infrared Scanning: Perform an additional follow-up infrared scan of each enclosed switch and circuit breaker 11 months after date of Substantial Completion.

c. Instruments and Equipment: Use an infrared scanning device designed to measure temperature or to detect significant deviations from normal values. Provide calibration record for device.

5. Test and adjust controls, remote monitoring, and safeties. Replace damaged and malfunctioning controls and equipment.

D. Enclosed switches and circuit breakers will be considered defective if they do not pass tests and inspections.

E. Prepare test and inspection reports.

1. Test procedures used.

2. Include identification of each enclosed switch and circuit breaker tested and describe test results.

3. List deficiencies detected, remedial action taken, and observations after remedial action.

3.6 ADJUSTING

A. Adjust moving parts and operable components to function smoothly, and lubricate as recommended by manufacturer.

B. Set field-adjustable circuit-breaker trip ranges as specified in Section 260573.16 "Coordination Studies".

END OF SECTION 262816

SECTION 264313 - SURGE PROTECTION FOR LOW-VOLTAGE ELECTRICAL POWER CIRCUITS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section includes:

1. Type 1 surge protective devices.
2. Type 2 surge protective devices.
3. Type 3 Surge Protective devices.
4. Enclosures.
5. Conductors and cables.

B. Related Requirements:

1. Section 262413 "Switchboards" for integral SPDs installed by switchboard manufacturer.
2. Section 262416 "Panelboards" for integral SPDs installed by panelboard manufacturer.
3. Section 262726 "Wiring Devices" for integral SPDs installed by receptacle manufacturer.

1.3 DEFINITIONS

A. Inominal: Nominal discharge current.

B. MCOV: Maximum continuous operating voltage.

C. Mode(s), also Modes of Protection: air of electrical connections where the VPR applies.

D. MOV: Metal-oxide varistor; an electronic component with a significant non-ohmic current-voltage characteristic.

E. NRTL: Nationally recognized testing laboratory.

F. OCPD: Overcurrent protective device.

G. SCCR: Short-circuit current rating.

H. SPD: Surge protective device.

I. Type 1 SPDs: Permanently connected SPDs intended for installation between the secondary of the service transformer and the line side of the service disconnect overcurrent device.

J. Type 2 SPDs: Permanently connected SPDs intended for installation on the load side of the service disconnect overcurrent device, including SPDs located at the branch panel. All branch circuit panelboards shall include SPD's

K. Type 3 SPDs: Point of utilization SPDs.

L. Type 4 SPDs: Component SPDs, including discrete components, as well as assemblies.

M. Type 5 SPDs: Discrete component surge suppressors, such as MOVs that may be mounted on a printed wiring board, connected by its leads or provided within an enclosure with mounting means and wiring terminations.

N. VPR: Voltage protection rating.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Include electrical characteristics, specialties, and accessories for SPDs.
2. NRTL certification of compliance with UL 1449.

a. Tested values for VPRs.
b. Inominal ratings.
c. MCOV, type designations.
d. OCPD requirements.
e. Manufacturer's model number.
f. System voltage.
g. Modes of protection.

1.5 INFORMATIONAL SUBMITTALS

A. Field quality-control reports.

B. Sample Warranty: For manufacturer's special warranty.

1.6 CLOSEOUT SUBMITTALS

A. Maintenance Data: For SPDs to include in maintenance manuals.

1.7 WARRANTY

A. Manufacturer's Warranty: Manufacturer agrees to repair or replace SPDs that fail in materials or workmanship within five years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 TYPE 1 SURGE PROTECTIVE DEVICES (SPDs)

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. ABB (Electrification Products Division).
2. DITEK Surge Protection.
3. Eaton.
4. Leviton Manufacturing Co., Inc.
5. Liebert; a brand of Vertiv.
6. Schneider Electric USA, Inc.
7. Siemens Industry, Inc., Energy Management Division.

B. Source Limitations: Obtain devices from single source from single manufacturer.

C. Standards:

1. Listed and labeled by an NRTL acceptable to authorities having jurisdiction as complying with UL 1449, Type 1.

D. Product Options:

1. Include integral disconnect switch.
2. Include internal thermal protection that disconnects the SPD before damaging internal suppressor components.
3. Include indicator light display for protection status.
4. Include audible alarm.
5. Include NEMA ICS 5, dry Form C contacts rated at 2 A and 24 V ac for remote monitoring of protection status.
6. Include surge counter.

E. Performance Criteria:

1. MCOV: Not less than 125 percent of nominal system voltage for 208Y/120 V and 120/240 V power systems, and not less than 115 percent of nominal system voltage for 480Y/277 V power systems.
2. Peak Surge Current Rating: Minimum single-pulse surge current withstand rating per phase must not be less than 240 kA. Peak surge current rating must be arithmetic sum of the ratings of individual MOVs in a given mode.
3. Protection modes and UL 1449 VPR for grounded wye circuits with 480Y/277 V or 208Y/120 V, three-phase, four-wire circuits must not exceed the following:

a. Line to Neutral: [1200 V for 480Y/277 V] [700 V for 208Y/120 V].
b. Line to Line: [2000 V for 480Y/277 V] [1200 V for 208Y/120 V].

4. Protection modes and UL 1449 VPR for 240/120 V, single-phase, three-wire circuits must not exceed the following:

a. Line to Neutral: 700 V.
b. Line to Line: 1200 V.

5. SCCR: Not less than 200 kA.
6. Inominal Rating: 20 kA.

2.2 TYPE 2 SURGE PROTECTIVE DEVICES (SPDs)

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. ABB (Electrification Products Division).
2. Advanced Protection Technologies Inc. (APT).
3. Eaton.
4. Leviton Manufacturing Co., Inc.
5. Liebert; a brand of Vertiv.
6. Schneider Electric USA, Inc.
7. Siemens Industry, Inc., Energy Management Division.

B. Source Limitations: Obtain devices from single source from single manufacturer.

C. Standards:

1. Listed and labeled by an NRTL acceptable to authorities having jurisdiction as complying with UL 1449, Type 2.
2. Comply with UL 1283.

D. Product Options:

1. Include LED indicator lights for power and protection status.
2. Include internal thermal protection that disconnects the SPD before damaging internal suppressor components.
3. Include NEMA ICS 5, dry Form C contacts rated at 2 A and 24 V ac for remote monitoring of protection status.
4. Include surge counter.

E. Performance Criteria:

1. MCOV: Not less than 125 percent of nominal system voltage for 208Y/120 V and 120/240 V power systems, and not less than 115 percent of nominal system voltage for 480Y/277 V power systems.
2. Peak Surge Current Rating: Minimum single-pulse surge current withstand rating per phase must not be less than 150 kA. Peak surge current rating must be arithmetic sum of the ratings of individual MOVs in a given mode.
3. Protection modes and UL 1449 VPR for grounded wye circuits with 480Y/277 V or 208Y/120 V, three-phase, four-wire circuits must not exceed the following:

a. Line to Neutral: [1200 V for 480Y/277 V] [700 V for 208Y/120 V].
b. Line to Ground: [1200 V for 480Y/277 V] [700 V for 208Y/120 V].

c. Neutral to Ground: [1200 V for 480Y/277 V] [700 V for 208Y/120 V].
d. Line to Line: [2000 V for 480Y/277 V] [1200 V for 208Y/120 V].

4. Protection modes and UL 1449 VPR for 240/120 V, single-phase, three-wire circuits must not exceed the following:

a. Line to Neutral: 700 V.
b. Line to Ground: 700 V.
c. Neutral to Ground: 700 V.
d. Line to Line: 1200 V.

5. SCCR: Equal or exceed 200 kA.
6. Inominal Rating: 20 kA.

2.3 TYPE 3, TYPE 4, AND TYPE 5 SURGE PROTECTIVE DEVICES (SPDs)

A. Type 3, Type 4, and Type 5 SPDs are not approved for field installation.

2.4 ENCLOSURES

A. Indoor Enclosures: NEMA 250, Type 1.

B. Outdoor Enclosures: NEMA 250, Type 3R.

2.5 CONDUCTORS AND CABLES

A. Power Wiring: Same size as SPD leads, complying with Section 260519 "Low-Voltage Electrical Power Conductors and Cables."

PART 3 - EXECUTION

3.1 INSTALLATION

A. Comply with NECA 1.

B. Provide and install Class I SPD at each main distribution panelboard. Provide and install Class II SPD at each distribution panelboard. Provide and install Class III SPD at each branch circuit panelboard.

C. Provide OCPD and disconnect for installation of SPD in accordance with UL 1449 and manufacturer's written instructions.

D. Install leads between disconnects and SPDs short, straight, twisted, and in accordance with manufacturer's written instructions. Comply with wiring methods in Section 260519 "Low-Voltage Electrical Power Conductors and Cables."

1. Do not splice and extend SPD leads unless specifically permitted by manufacturer.
2. Do not exceed manufacturer's recommended lead length.
3. Do not bond neutral and ground.

E. Use crimped connectors and splices only. Wire nuts are unacceptable.

3.2 FIELD QUALITY CONTROL

A. Perform the following tests and inspections with the assistance of a factory-authorized service representative:

1. Compare equipment nameplate data for compliance with Drawings and the Specifications.
2. Inspect anchorage, alignment, grounding, and clearances.
3. Verify that electrical wiring installation complies with manufacturer's written installation requirements.

B. SPDs that do not pass tests and inspections will be considered defective.

C. Prepare test and inspection reports.

3.3 STARTUP SERVICE

A. Complete startup checks in accordance with manufacturer's written instructions.

B. Do not perform insulation-resistance tests of the distribution wiring equipment with SPDs installed. Disconnect SPDs before conducting insulation-resistance tests; reconnect them immediately after the testing is over.

C. Energize SPDs after power system has been energized, stabilized, and tested.

3.4 DEMONSTRATION

A. Train Owner's maintenance personnel to operate and maintain SPDs.

END OF SECTION 264313

SECTION 265100 GENERAL INTERIOR LUMINAIRES

PART 1 - GENERAL

1.01 SCOPE

A. Furnish all labor, materials, equipment, appliances and perform all operations in connection with, and complete in strict accordance with, this section of specifications and the applicable drawings and subject to the terms and conditions of the contract for the following work:

1. Interior luminaires and accessories.
2. Emergency lighting units.
3. Exit signs.
4. Ballasts.
5. Fluorescent lamp emergency power supply.
6. Lamps.
7. Luminaire accessories.

1.02 APPLICABLE SECTIONS

A. The General Conditions, Supplementary General Conditions, alternates and Addenda, applicable drawings and the technical specification including but not limited to the following;

B. Section 260500- Electrical General Requirements.

1.03 REFERENCES

A. ANSI C78.379 - Electric Lamps - Incandescent and Issued October 1993 High-Intensity Discharge Reflector Lamps - Classification of Beam Patterns.

B. ANSI C82.1 - Ballasts for Fluorescent Lamps -Specifications.

C. ANSI C82.4 - Ballasts for High-Intensity Discharge and Low Pressure Sodium Lamps (Multiple Supply Type).

D. NEMA WD 6 - Wiring Devices-Dimensional Requirements.

E. NFPA 70 - National Electrical Code.

F. NFPA 101 - Life Safety Code.

1.04 SUBMITTALS FOR REVIEW

A. Section 260500 - Electrical General Requirements

B. Shop Drawings: Indicate dimensions and components for each luminaire that is not a standard product of the manufacturer.

C. Product Data: Provide dimensions, ratings, and performance data.

1.05 SUBMITTALS FOR CLOSEOUT

A. Section 260500 - Electrical General Requirements

B. Submit manufacturer's operation and maintenance instructions for each product.

1.06 QUALIFICATIONS

A. Manufacturer: Company specializing in manufacturing the Products specified in this section with minimum five years documented experience.

1.07 REGULATORY REQUIREMENTS

A. Conform to requirements of NFPA 70.

B. Conform to requirements of NFPA 101.

C. Products: Listed and classified by Underwriters Laboratories, Inc. as suitable for the purpose specified and indicated.

1.08 EXTRA PRODUCTS

A. Section 260500 - Contract Closeout.

B. Furnish 10% or a minimum of two of each lens type.

C. Furnish one case of replacement fluorescent lamps for each lamp type. Furnish two replacement lamps for each size HID lamp type and LED assembly.

D. Furnish % or a minimum of two of each ballast type or driver type.

PART 2 - PRODUCTS

2.01 LUMINAIRES

A. Furnish Products as scheduled. Refer to Section 260500 for substitutions and product options.

B. Lighting Fixtures: Shall be as shown in the Lighting Fixture Schedule on the Drawings.

2.04 LED LUMINAIRE WARRANTY

a. Provide a written 5-year on-site replacement warranty for material, fixture finish, and workmanship. On-site replacement includes transportation, removal, and installation of new products.

(1) Include finish warranty to include failure and substantial deterioration such as blistering, cracking, peeling, chalking, or fading.

(2) Material warranty must include:

(a) All drivers.

(b) Replacement when more than 10 percent of LED sources in any lightbar or subassembly(s) are defective or non-starting.

b. Warranty period must begin on date of beneficial occupancy. Provide the Contracting Officer with signed warranty certificates prior to final payment.

2.05 PROVIDE LUMINAIRE USEFUL LIFE CERTIFICATE

Submit certification from the manufacturer indicating the expected useful life of the luminaires provided. The useful life must be directly correlated from the IES LM-80 test data using procedures outlined in IES TM-21. Thermal properties of the specific luminaire and local ambient operating temperature and conditions must be taken into consideration.

2.06 LUMINAIRES

UL 1598, NEMA C82.77, and UL 8750. Provide luminaires as indicated in luminaire schedule and NL plates or details on project plans. Provide luminaires complete with light sources of quantity, type, and wattage indicated. Provide all luminaires of the same type by the same manufacturer. Luminaires must be specifically designed for use with the driver, ballast or generator and light source provided.

2.07 LED LUMINAIRES

Provide luminaires complete with power supplies (drivers) and light sources. Provide design information including lumen output and design life in luminaire schedule on project plans for LED luminaires. LED luminaires must meet the minimum requirements in the following table:

LUMINAIRE TYPE	MINIMUM LUMINAIRE EFFICACY (LE)	MINIMUM COLOR RENDERING INDEX (CRI)
LED TROFFER – 1 x 4300 x 1200 2 x 2600 x 600 2 x 4600 x 1200	90 LPW	90
LED Downlight	50 LPW	90
LED Track or Accent	40 LPW	80
LED Low Bay/High Bay	80 LPW	80
LED Linear Ambient	80 LPW	80

LED luminaires must also meet the following minimum requirements:

a. Luminaires must have a minimum 5-year manufacturer's warranty.

b. Luminaires must have a minimum L70 lumen maintenance value of 50,000 hours as calculated by IES TM-21, with data obtained per IES LM-80

requirements.

c. Luminaire drive current value must be identical to that provided by test data for luminaire in question.

d. Luminaires must be tested to IES LM-79 and IES LM-80 standards, with the results provided as required in the Submittals paragraph of this specification.

2.08 DRIVERS, BALLASTS AND GENERATORS

2.09 LED Drivers

NEMA SSL 1, UL 8750. LED drivers must be electronic, UL Class 1, constant-current type and comply with the following requirements:

a. Output power (watts)and luminous flux (lumens) as shown in luminaire schedule for each luminaire type to meet minimum luminaire efficacy (LE) value provided.

b. Factor (PF) greater than or equal to 0.9 over the full dimming range when provided.

c. Current draw Total Harmonic Distortion (THD) of less than 20 percent.

d. Class A sound rating.

e. Operable at input voltage of 120-277 volts at 60 hertz.

f. Minimum 5-year manufacturer's warranty.

g. RoHS compliant.

h. Integral thermal protection that reduces or eliminates the output power if case temperature exceeds a value detrimental to the driver.

i. UL listed for dry or damp locations typical of interior installations.

j. Non-dimmable, or fully-dimmable to 1% using 0-10V, or 3 wire, control as indicated in luminaire schedule and on drawings.

2.16 LIGHT SOURCES

NEMA ANSLG C78.377, NEMA SSL 3. Provide type and wattage as indicated in luminaire schedule on project plans.

A. LED Light Sources

a. Correlated Color Temperature (CCT) of 3000 or 4000 degrees K as indicated.

b. Minimum Color Rendering Index (CRI) R9 value of 80, 90 in instruction rooms, celestial room, and sealing rooms.

c. High power, white light output utilizing phosphor conversion (PC) process or mixed system of colored LEDs, typically red, green and blue (RGB).

d. RoHS compliant.

e. Provide light source color consistency by utilizing a binning tolerance within a 2 step McAdam ellipse.

PART 3 - EXECUTION

3.01 INSTALLATION

A. Install suspended luminaires using pendants supported from swivel hangers. Provide pendant length required to suspend luminaire at indicated height.

B. Support luminaires independent of ceiling grid, if layin type ceilings or concealed spline ceilings ore used.

C. Locate recessed ceiling luminaires as indicated on reflected ceiling plan.

D. Install surface mounted luminaires plumb and adjust to align with building lines and with each other. Secure to prevent movement.

3.02 INSTALLATION OF LIGHTING FIXTURES

A. Install all lighting fixtures complete and ready for service, in accordance with the Fixture Schedule on the Drawings:

B. Wire all fixtures with fixture wiring of at least 150 degree C rating. Conductors in wiring channels of fixtures mounted in rows shall be the same size as the circuit wiring supplying the rows.

C. Install all fluorescent fixtures straight and true with reference to adjacent walls.

D. Install all lighting fixtures, including those mounted in continuous rows, so that the weight of the fixture is supported either directly or indirectly by a sound and safe structural member of the building, using adequate number and type of fasteners to ensure a safe installation. Screwed fastenings and toggles through ceiling or wall material are not acceptable. Provide suitable connectors or collars to connect adjoining fixtures in continuous rows.

E. Do not support fixtures from roof deck. Provide unistrut channels spanning space between roof joists to support fixtures and outlets.

F. Fixtures mounted in lay-in grid ceilings shall have safety support wires to structural roof members as detailed for seismic restraint.

G. All single outlets shall be properly centered in each room. Where two or more outlets occur, they shall be spaced uniformly and in straight lines with each other.

H. Provide plaster frames and support channels around ceiling openings for recessed fixtures. Securely fasten to ceiling structural members.

I. Terminate circuits for recessed fixtures in an extension outlet box adjacent to ceiling opening and connect to fixtures with flexible steel conduit.

J. Where lighting fixtures and other electrical items are shown in conflict with locations and

structural members and mechanical or other equipment, provide all required supports and wiring to clear the encroachment.

3.03 ADJUSTING

A. Section 260500 Contract Closeout

3.04 CLEANING

A. Section 260500 - Contract Closeout: Cleaning installed work.

B. Clean electrical parts to remove conductive and deleterious materials.

C. Remove dirt and debris from enclosures.

D. Clean photometric control surfaces as recommended by manufacturer.

E. Clean finishes and touch up damage.

3.05 DEMONSTRATION AND INSTRUCTIONS

A. Section 260500 - Contract Closeout - Starting of Systems: Demonstrating installed work.

B. Demonstrate luminaire operation for 12 hours.

3.06 PROTECTION OF FINISHED WORK

A. Re-lamp or repair/replace luminaires that have failed at substantial completion.

END OF SECTION 265100

SECTION 270526 - 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 rods.
5. Grounding labeling.

1.3 DEFINITIONS

A. BCT: Bonding conductor for telecommunications.

B. TGB: Telecommunications grounding busbar.

C. TMGB: Telecommunications main grounding busbar.

D. Service Provider: The operator of a service that provides telecommunications transmission delivered over access provider facilities.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product.

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 rods.
2. Ground and roof rings.
3. 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 agencies 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 Level 2 Installer, who shall be present at all times when Work of this Section is performed at Project site.

2. Field Inspector: Currently registered by BICSI as a designer RCDD to perform the on-site inspection.

PART 2 - PRODUCTS

2.1 SYSTEM DESCRIPTION

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

B. Comply with UL 467 for grounding and bonding materials and equipment.

C. Comply with TIA-607-B.

2.2 CONDUCTORS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Harger Lightning & Grounding.

2. Panduit Corp.

3. TE Connectivity Ltd.

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 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.

2. Not smaller than No. 10 AWG and not longer than 12 inches (300 mm). If jumper is a wire, it shall have a crimped grounding lug with one hole and standard barrel for one crimp. If jumper is a flexible braid, it shall have a one- or two-hole ferrule. Attach with grounding screw or connector provided by cable tray manufacturer.

E. Bare Copper Conductors:

1. Solid Conductors: ASTM B3.

2. Stranded Conductors: ASTM B8.

3. Tinned Conductors: ASTM B33.

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. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Chatsworth Products, Inc.

2. Harger Lightning & Grounding.

3. Hubbell Incorporated (Construction and Energy Group).

4. Panduit Corp.

5. TE Connectivity Ltd.

B. 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.

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. Signal Reference Grid Connectors: Combination of compression wire connectors, access floor grounding clamps, bronze U-bolt grounding clamps, and copper split-bolt connectors, designed for the purpose.

E. Busbar Connectors: Cast silicon bronze, solderless compression 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.

F. Welded Connectors: Exothermic-welding kits of types recommended by kit manufacturer for materials being joined and installation conditions.

2.4 GROUNDING BUSBARS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Chatsworth Products, Inc.

2. Harger Lightning & Grounding.

3. Panduit Corp.

B. TMGB: Predrilled, wall-mounted, rectangular bars of hard-drawn solid copper, 1/4 by 4 inches (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 TIA-607-B.

1. Predrilling shall be with holes for use with lugs specified in this Section.

2. Mounting Hardware: Stand-off brackets that provide a 4-inch (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 TIA-607-B.

1. Predrilling shall be with holes for use with lugs specified in this Section.

2. Mounting Hardware: Stand-off brackets that provide at least a 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 TIA-607-B. 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 GROUND RODS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Harger Lightning & Grounding.

2. TE Connectivity Ltd.

B. Ground Rods: Copper-clad, steel; 3/4 inch by 10 feet (19 mm by 3 m) in diameter.

2.6 IDENTIFICATION

A. Comply with requirements for identification products in Section 270553 "Identification for Communications Systems."

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine the ac grounding electrode system and equipment grounding for compliance with requirements for maximum ground-resistance level and other conditions affecting performance of grounding and bonding of the electrical system.

B. Inspect the test results of the ac grounding system measured at the point of BCT connection.

C. Prepare written report, endorsed by Installer, listing conditions detrimental to performance of the Work.

D. Proceed with connection of the BCT only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Bonding shall include the ac utility power service entrance, the communications cable entrance, and the grounding electrode system. The bonding of these elements shall form a loop so that each element is connected to at least two others.

B. Comply with NECA 1.

C. Comply with TIA-607-B.

3.3 APPLICATION

A. Conductors: Install solid conductor for No. 8 AWG and smaller and stranded conductors for No. 6 AWG and larger unless otherwise indicated.

1. The bonding conductors between the TGB and structural steel of steel-frame buildings shall not be smaller than No. 6 AWG.

2. The bonding conductors between the TMGB and structural steel of steel-frame buildings shall not be smaller than No. 6 AWG.

B. Underground Grounding Conductors: Install bare tinned-copper conductor, No. 4/0 AWG minimum.

C. Conductor Terminations and Connections:

1. Pipe and Equipment Grounding Conductor Terminations: Bolted connectors.

2. Underground Connections: Welded connectors except at test wells and as otherwise indicated.

3. Connections to Ground Rods at Test Wells: Bolted connectors.

4. Connections to Structural Steel: Welded connectors.

D. Conductor Support:

1. Secure grounding and bonding conductors at intervals of not less than 36 inches (900 mm).

E. Grounding and Bonding Conductors:

1. Install in the straightest and shortest route between the origination and termination point, and no longer than required. The bend radius shall not be smaller than eight times the diameter of the conductor. No one bend may exceed 90 degrees.

2. Install without splices.

3. Support at not more than 36-inch (900-mm) intervals.

4. Install grounding and bonding conductors in 3/4-inch (21-mm) PVC conduit until conduit enters a telecommunications room. The grounding and bonding conductor pathway through a plenum shall be in EMT. Conductors shall not be installed in EMT unless otherwise indicated.

a. If a grounding and bonding conductor is installed in ferrous metallic conduit, bond the conductor to the conduit using a grounding bushing that complies with requirements in Section 270528 "Pathways for Communications Systems," and bond both ends of the conduit to a TGB.

3.4 GROUNDING ELECTRODE SYSTEM

A. The BCT between the TMGB and the ac service equipment ground shall not be smaller than No.4/0 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.

B. Where indicated on both sides of doorways, route bus up to top of door frame, across top of doorway, and down; connect to horizontal bus.

3.6 CONNECTIONS

A. Bond metallic equipment in a telecommunications equipment room to the grounding busbar in that room, using equipment grounding conductors not smaller than No. 6 AWG.

B. Stacking of conductors under a single bolt is not permitted when connecting to busbars.

C. Assemble the wire connector to the conductor, complying with manufacturer's written instructions and as follows:

1. Use crimping tool and the die specific to the connector.

2. Pretwist the conductor.

3. Apply an antioxidant compound to all bolted and compression connections.

D. Primary Protector: Bond to the TMGB with insulated bonding conductor.

E. 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 unless otherwise indicated.

F. Telecommunications Enclosures and Equipment Racks: Bond metallic components of enclosures to the telecommunications bonding and grounding system. Install rack grounding busbar at most effective location (Field Coordinate) 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. Electrical Power Panelboards: Where an electrical panelboard for telecommunications equipment is located in the same room or space, bond each TGB to the ground bar of the panelboard.

I. Shielded Cable: Bond the shield of shielded cable to the TGB in communications rooms and spaces. Comply with TIA-568-C.1 and TIA-568-C.2 when grounding shielded balanced twisted-pair cables.

J. 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.

K. Access Floors: Bond all metal parts of access floors to the TGB.

L. Equipment Room Signal Reference Grid: Provide a low-impedance path between telecommunications cabinets, equipment racks, and the reference grid, using No. 6 AWG bonding conductors.

1. Install the conductors in grid pattern on 4-foot (1200-mm) centers, allowing bonding of one pedestal from each access floor tile.

2. Bond the TGB of the equipment room to the reference grid at two or more locations.

3. Bond all conduits and piping entering the equipment room to the TGB at the perimeter of the room.

M. Towers and Antennas:

1. Ground Ring: Buried at least 30 inches (760 mm) below grade and at least 24 inches (610 mm) from the base of the tower or mounting.

2. Bond each tower base and metallic frame of a dish to the ground ring, buried at least 18 inches (460 mm) below grade.

3. Bond the ground ring and antenna grounds to the equipment room TMGB or TGB, buried at least 30 inches (760 mm) below grade.

4. Bond metallic fences within 6 feet (1.8 m) of towers and antennas to the ground ring, buried at least 18 inches (460 mm) below grade.

5. Special Requirements for Roof-Mounted Towers:

a. Roof Ring: Meet requirements for the ground ring except the conductors shall comply with requirements in Section 264113 "Lightning Protection for Structures."

b. Bond tower base footings steel, the TGB in the equipment room, and antenna support guys to the roof ring.

c. Connect roof ring to the perimeter conductors of the lightning protection system.

6. Waveguides and Coaxial Cable:

a. Bond cable shields at the point of entry into the building to the TGB and to the cable entrance plate, using No. 2 AWG bonding conductors.

b. Bond coaxial cable surge arrester to the ground or roof ring using bonding conductor size recommended by surge-arrester manufacturer.

3.7 GROUNDING UNDERGROUND DISTRIBUTION SYSTEM COMPONENTS

A. Duct-Bank Grounding Conductor: Bury 12 inches (300 mm) above duct bank when indicated as part of duct-bank installation.

B. Comply with IEEE C2 grounding requirements.

C. Grounding Manholes and Handholes: Install a driven ground rod through manhole or handhole floor, close to wall, and set rod depth so 4 inches (100 mm) extends above finished floor. If necessary, install ground rod before manhole is placed and provide No. 1/0 AWG bare, tinned-copper conductor from ground rod into manhole through a waterproof sleeve in manhole wall. Protect ground rods passing through concrete floor with a double wrapping of pressure-sensitive insulating tape or heat-shrunk insulating sleeve from 2 inches (50 mm) above to 6 inches (150 mm) below concrete. Seal floor opening with waterproof, nonshrink grout.

D. Grounding Connections to Manhole Components: Bond exposed-metal parts such as inserts, cable racks, pulling irons, ladders, and cable shields within each manhole or handhole, to ground rod or grounding conductor. Make connections with No. 4 AWG minimum, bonding conductor. Train conductors level or plumb around corners and fasten to manhole walls. Connect grounding conductors to cable armor and cable shields according to written instructions by manufacturer of splicing and termination kits.

3.8 IDENTIFICATION

A. Labels shall be preprinted or computer-printed type.

1. Label TMGB(s) with "fs-TMGB," where "fs" is the telecommunications space identifier for the space containing the TMGB.

2. Label TGB(s) with "fs-TGB," where "fs" is the telecommunications space identifier for the space containing the TGB.

3. Label the BCT and each telecommunications backbone conductor at its attachment point: "WARNING! TELECOMMUNICATIONS BONDING CONDUCTOR. DO NOT REMOVE OR DISCONNECT!"

3.9 FIELD QUALITY CONTROL

A. 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. 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 270526

SECTION 270528 - PATHWAYS FOR COMMUNICATIONS SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Metal conduits and fittings.
2. Nonmetallic conduits and fittings.
3. Optical-fiber-cable pathways and fittings.
4. Metal wireways and auxiliary gutters.
5. Nonmetallic wireways and auxiliary gutters.
6. Metallic surface pathways.
7. Nonmetallic surface pathways.
8. Tele-power poles.
9. Hooks.
10. Boxes, enclosures, and cabinets.
11. Polymer-concrete handholes and boxes for exterior underground cabling.
12. Fiberglass handholes and boxes for exterior underground cabling.

1.3 DEFINITIONS

A. ARC: Aluminum rigid conduit.

B. GRC: Galvanized rigid conduit.

C. IMC: Intermediate metal conduit.

D. RTRC: Reinforced thermosetting resin conduit.

1.4 ACTION SUBMITTALS

A. Product data for the following:

1. Surface pathways
2. Wireways and fittings.

3. Tele-power poles.

4. Boxes, enclosures, and cabinets.

5. Underground handholes and boxes.

B. Shop Drawings: For custom enclosures and cabinets and custom underground handholes and boxes. Include plans, elevations, sections, and attachment details.

1.5 INFORMATIONAL SUBMITTALS

A. Coordination Drawings: Pathway routing plans, drawn to scale, on which the following items are shown and coordinated with each other, using input from installers of items involved:

1. Structural members in paths of pathway groups with common supports.

2. HVAC and plumbing items and architectural features in paths of conduit groups with common supports.

3. Underground ducts, piping, and structures in location of underground enclosures and handholes.

B. Qualification Data: For professional engineer.

C. Seismic Qualification Data: Seismic rating and seismic bracing for all pathway racks, enclosures, cabinets, equipment racks, and their mounting provisions, including those for internal components, from manufacturer.

1. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.

2. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.

3. Detailed description of equipment anchorage devices on which certification is based and their installation requirements.

4. Detailed description of conduit support devices and interconnections on which certification is based and their installation requirements.

D. Source quality-control reports.

PART 2 - PRODUCTS

2.1 METAL CONDUITS AND FITTINGS

A. Description: Metal raceway of circular cross section with manufacturer-fabricated fittings.

B. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. AFC Cable Systems; a part of Atkore International.

2. Allied Tube & Conduit; a part of Atkore International.

3. Alpha Wire.
4. Anamet Electrical, Inc (Anaconda Sealtite).
5. O-Z/Gedney; a brand of Emerson Industrial Automation.
6. Picoma Industries, Inc.
7. Plasti-Bond.
8. Republic Conduit.
9. Southwire Company.
10. Thomas & Betts Corporation; A Member of the ABB Group.
11. Western Tube and Conduit Corporation.
12. Wheatland Tube Company.

C. General Requirements for Metal Conduits and Fittings:

1. Listed and labeled as defined in NFPA 70, by a nationally recognized testing laboratory, and marked for intended location and application.
2. Comply with TIA-569-D.

D. GRC: Comply with ANSI C80.1 and UL 6.

E. ARC: Comply with ANSI C80.5 and UL 6A.

F. IMC: Comply with ANSI C80.6 and UL 1242.

G. PVC-Coated Steel Conduit: PVC-coated GRC.

1. Comply with NEMA RN 1.
2. Coating Thickness: 0.040 inch (1 mm), minimum.

H. EMT: Comply with ANSI C80.3 and UL 797.

I. Fittings for Metal Conduit: Comply with NEMA FB 1 and UL 514B.

1. Conduit Fittings for Hazardous (Classified) Locations: Comply with UL 1203 and NFPA 70.
2. Fittings for EMT:
   a. Material: Steel.
   b. Type: Set screw or compression.
3. Expansion Fittings: PVC or steel to match conduit type, complying with UL-467, rated for environmental conditions where installed, and including flexible external bonding jumper.

4. Coating for Fittings for PVC-Coated Conduit: Minimum thickness of 0.040 inch (1 mm), with overlapping sleeves protecting threaded joints.

J. Joint Compound for IMC, GRC, or ARC: Approved, as defined in NFPA 70, by authorities having jurisdiction for use in conduit assemblies, and compounded for use to lubricate and protect threaded conduit joints from corrosion and to enhance their conductivity.

2.2 NONMETALLIC CONDUITS AND FITTINGS

A. Description: Nonmetallic raceway of circular section with manufacturer-fabricated fittings.

B. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. AFC Cable Systems; a part of Atkore International.

2. Allied Tube & Conduit; a part of Atkore International.

3. Anamet Electrical, Inc (Anaconda Sealtite).

4. Cantex Inc.

5. Carlon; a brand of Thomas & Betts Corporation.

6. CertainTeed Corporation.

7. Condux International, Inc.

8. Electri-Flex Company.

9. Hubbell Incorporated (Commercial and Industrial Group - RACO).

10. Kraloy Fittings.

11. Lamson & Sessions.

12. Niedax Inc.

13. Thomas & Betts Corporation; A Member of the ABB Group.

C. General Requirements for Nonmetallic Conduits and Fittings:

1. Listed and labeled as defined in NFPA 70, by an NRTL, and marked for intended location and application.

2. Comply with TIA-569-D.

D. RNC: Type EPC-40-PVC, complying with NEMA TC 2 and UL 651 unless otherwise indicated.

E. Rigid HDPE: Comply with UL 651A.

F. Continuous HDPE: Comply with UL 651A.

G. RTRC: Comply with UL 2515A and NEMA TC 14.

H. Fittings: Comply with NEMA TC 3; match to conduit or tubing type and material.

I. Solvents and Adhesives: As recommended by conduit manufacturer.

2.3 OPTICAL-FIBER-CABLE PATHWAYS AND FITTINGS

A. Description: Comply with UL 2024; flexible-type pathway with a circular cross section, approved for plenum installation unless otherwise indicated.

B. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Alpha Wire.

2. Carlon; a brand of Thomas & Betts Corporation.

3. Dura-Line.

4. Endot Industries Inc.

C. Listed and labeled as defined in NFPA 70, by an NRTL, and marked for intended location and application.

D. Comply with TIA-569-D.

2.4 METAL WIREWAYS AND AUXILIARY GUTTERS

A. Description: Sheet metal trough of rectangular cross section fabricated to required size and shape, without holes or knockouts, and with hinged or removable covers.

B. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. B-line, an Eaton business.

2. Hoffman; a brand of nVent.

3. MonoSystems, Inc.

4. Square D; by Schneider Electric.

C. General Requirements for Metal Wireways and Auxiliary Gutters:

1. Comply with UL 870 and NEMA 250, Type 1 or Type 3R as required unless otherwise indicated, and sized according to NFPA 70.

2. Metal wireways installed outdoors shall be listed and labeled as defined in NFPA 70, by an NRTL, and marked for intended location and application.

3. Comply with TIA-569-D.

D. Fittings and Accessories: Include covers, couplings, offsets, elbows, expansion joints, adapters, hold-down straps, end caps, and other fittings to match and mate with wireways as required for complete system.

E. Wireway Covers: Hinged type unless otherwise indicated.

F. Finish: Manufacturer's standard enamel finish.

2.5 NONMETALLIC WIREWAYS AND AUXILIARY GUTTERS

A. Description: Fiberglass polyester, extruded and fabricated to required size and shape, without holes or knockouts. Cover shall be gasketed with oil-resistant gasket material and fastened with captive screws treated for corrosion resistance. Connections shall be flanged and have stainless-steel screws and oil-resistant gaskets.

B. Description: PVC, extruded and fabricated to required size and shape, and having snap-on cover, mechanically coupled connections, and plastic fasteners.

C. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Allied Moulded Products, Inc.

2. Carlon; a brand of Thomas & Betts Corporation.

3. Hoffman; a brand of nVent.

4. Niedax Inc.

D. General Requirements for Nonmetallic Wireways and Auxiliary Gutters:

1. Listed and labeled as defined in NFPA 70, by an NRTL, and marked for intended location and application.

2. Comply with TIA-569-D.

E. Fittings and Accessories: Couplings, offsets, elbows, expansion joints, adapters, hold-down straps, end caps, and other fittings shall match and mate with wireways as required for complete system.

F. Solvents and Adhesives: As recommended by conduit manufacturer.

2.6 SURFACE METAL PATHWAYS

A. Description: Galvanized steel with snap-on covers, complying with UL 5.

B. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. MonoSystems, Inc.

2. Niedax Inc.

3. Panduit Corp.

4. Wiremold / Legrand.

C. Finish: Manufacturer's standard enamel finish in color selected by Architect.

D. Listed and labeled as defined in NFPA 70, by an NRTL, and marked for intended location and application.

E. Comply with TIA-569-D.

2.7 SURFACE NONMETALLIC PATHWAYS:

A. Description: Two- or three-piece construction, complying with UL 5A, and manufactured of rigid PVC.

B. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Carlon; a brand of Thomas & Betts Corporation.

2. Hubbell Incorporated (Power Systems Group - Quazite).

3. MonoSystems, Inc.

4. Panduit Corp.

5. Wiremold / Legrand.

C. Finish: Texture and color selected by Architect from manufacturer's standard colors.

D. Product shall comply with UL 94 V-0 requirements for self-extinguishing characteristics.

E. Listed and labeled as defined in NFPA 70, by an NRTL, and marked for intended location and application.

F. Comply with TIA-569-D.

2.8 HOOKS

A. Description: Prefabricated sheet metal cable supports for telecommunications cable.

B. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. MonoSystems, Inc.

2. Panduit Corp.

3. Wiremold / Legrand.

C. Listed and labeled as defined in NFPA 70, by an NRTL, and marked for intended location and application.

D. Comply with TIA-569-D.

E. Galvanized steel.

F. J shape.

2.9 BOXES, ENCLOSURES, AND CABINETS

A. Description: Enclosures for communications.

B. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Adalet.
2. Carlon; a brand of Thomas & Betts Corporation.
3. Crouse-Hinds, an Eaton business.
4. EGS/Appleton Electric.
5. Erickson Electrical Equipment Company.
6. FSR Inc.
7. Hoffman; a brand of nVent.
8. Hubbell Incorporated (Commercial and Industrial Group - RACO).
9. Hubbell Incorporated (Power Systems Group - Quazite).
10. Milbank Manufacturing Co.
11. Molex Industrial Products Group; Woodhead Brand.
12. MonoSystems, Inc.
13. Oldcastle Enclosure Solutions.
14. O-Z/Gedney; a brand of Emerson Industrial Automation.
15. Plasti-Bond.
16. Spring City Electrical Manufacturing Company.
17. Stahlin Non-Metallic Enclosures.
18. Thomas & Betts Corporation; A Member of the ABB Group.
19. Wiremold / Legrand.

C. General Requirements for Boxes, Enclosures, and Cabinets:

1. Comply with TIA-569-D.
2. Boxes, enclosures, and cabinets installed in wet locations shall be listed and labeled as defined in NFPA 70, by an NRTL, and marked for use in wet locations.
3. Box extensions used to accommodate new building finishes shall be of same material as recessed box.

4. Device Box Dimensions: 4 11/14 inches square by 2-1/8 inches deep.

5. Gangable boxes are prohibited.

D. Sheet Metal Outlet and Device Boxes: Comply with NEMA OS 1 and UL 514A.

E. Cast-Metal Outlet and Device Boxes: Comply with NEMA FB 1, ferrous alloy, Type FD, with gasketed cover.

F. Metal Floor Boxes:

1. Material: Cast metal.

2. Type: Fully adjustable.

3. Shape: Rectangular.

4. Metal floor boxes shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

G. Nonmetallic Floor Boxes: Nonadjustable, rectangular.

1. Nonmetallic floor boxes shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

H. Small Sheet Metal Pull and Junction Boxes: NEMA OS 1.

I. Cast-Metal Access, Pull, and Junction Boxes: Comply with NEMA FB 1 and UL 1773, cast aluminum with gasketed cover.

J. Nonmetallic Outlet and Device Boxes: Comply with NEMA OS 2 and UL 514C.

K. Hinged-Cover Enclosures: Comply with UL 50 and NEMA 250, Type 1 or Type 3R, with continuous-hinge cover with flush latch unless otherwise indicated.

1. Metal Enclosures: Steel, finished inside and out with manufacturer's standard enamel.

2. Nonmetallic Enclosures:

a. Material Fiberglass.

b. Finished inside with radio-frequency-resistant paint.

3. Interior Panels: Steel; all sides finished with manufacturer's standard enamel.

L. Cabinets:

1. NEMA 250, Type 1 galvanized-steel box with removable interior panel and removable front, finished inside and out with manufacturer's standard enamel.

2. Hinged door in front cover with flush latch and concealed hinge.

3. Key latch to match panelboards.

4. Metal barriers to separate wiring of different systems and voltage.

5. Accessory feet where required for freestanding equipment.

6. Nonmetallic cabinets shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

2.10 POLYMER-CONCRETE HANDHOLES

A. Description: Molded of sand and aggregate; bound together with polymer resin; and reinforced with steel, fiberglass, or a combination of the two.

B. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Armorcast Products Company.

2. Hubbell Incorporated (Power Systems Group - Quazite).

3. NewBasis.

4. Oldcastle Enclosure Solutions.

5. Oldcastle Enclosure Solutions.

6. Oldcastle Precast, Inc.

C. General Requirements for Polymer Concrete Handholes:

1. Boxes and handholes for use in underground systems shall be listed and labeled as defined in NFPA 70, by an NRTL, and marked for intended location and application.

2. Boxes installed in wet areas shall be listed and labeled as defined in NFPA 70, by an NRTL, and marked for intended location and application.

3. Comply with TIA-569-D.

D. Configuration: Designed for flush burial with integral closed bottom unless otherwise indicated.

E. Cover: Weatherproof, secured by tamper-resistant locking devices and having structural load rating consistent with enclosure and handhole location.

1. Cover Finish: Nonskid finish shall have a minimum coefficient of friction of 0.50.

2. Cover Legend: Molded lettering, "COMMUNICATIONS".

F. Conduit Entrance Provisions: Conduit-terminating fittings shall mate with entering ducts for secure, fixed installation in enclosure wall.

G. Handholes 12 Inches Wide by 24 Inches Long (300 mm Wide by 600 mm Long and Larger: Have inserts for cable racks and pulling-in irons installed before concrete is poured.

2.11 FIBERGLASS HANDHOLES AND BOXES

A. Description: Molded of fiberglass-reinforced polyester resin, with frame and covers of cast iron.

B. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Armorcast Products Company.

2. Hubbell Incorporated (Power Systems Group - Quazite).

3. Nordic Fiberglass, Inc.

4. Oldcastle Enclosure Solutions.

5. Oldcastle Enclosure Solutions.

6. Oldcastle Precast, Inc.

C. General Requirements for Fiberglass Handholes and Boxes:

1. Boxes and handholes for use in underground systems shall be listed and labeled as defined in NFPA 70, by an NRTL, and marked for intended location and application.

2. Boxes installed in wet areas shall be listed and labeled as defined in NFPA 70, by an NRTL, and marked for intended location and application.

3. Comply with TIA-569-D.

D. Color of Frame and Cover: Gray.

E. Configuration: Designed for flush burial with integral closed bottom unless otherwise indicated.

F. Cover: Weatherproof, secured by tamper-resistant locking devices and having structural load rating consistent with enclosure and handhole location.

G. Cover Finish: Nonskid finish shall have a minimum coefficient of friction of 0.50.

H. Cover Legend: Molded lettering, “COMMUNICATIONS”.

I. Conduit Entrance Provisions: Conduit-terminating fittings shall mate with entering ducts for secure, fixed installation in enclosure wall.

J. Handholes 12 Inches Wide by 24 Inches Long (300 mm Wide by 600 mm Long) and Larger: Have inserts for cable racks and pulling-in irons installed before concrete is poured.

2.12 SOURCE QUALITY CONTROL FOR UNDERGROUND ENCLOSURES

A. Handhole and Pull-Box Prototype Test: Test prototypes of handholes and boxes for compliance with SCTE 77. Strength tests shall be for specified tier ratings of products supplied.

1. Tests of materials shall be performed by an independent testing agency.

2. Strength tests of complete boxes and covers shall be by either an independent testing agency or manufacturer. A qualified registered professional engineer shall certify tests by manufacturer.

3. Testing machine pressure gages shall have current calibration certification complying with ISO 9000 and ISO 10012, and traceable to NIST standards.

PART 3 - EXECUTION

3.1 PATHWAY APPLICATION

A. Outdoors: Apply pathway products as specified below unless otherwise indicated:

1. Exposed Conduit: GRC or IMC

2. Concealed Conduit, Aboveground: EMT

3. Underground Conduit: RNC, Type EPC-40-PVC.

4. Boxes and Enclosures, Aboveground: NEMA 250, Type 3R.

B. Indoors: Apply pathway products as specified below unless otherwise indicated:

1. Exposed, Not Subject to Physical Damage: EMT.

2. Exposed, Not Subject to Severe Physical Damage: EMT.

3. Exposed and Subject to Severe Physical Damage: GRC or IMC. Pathway locations include the following:

a. Loading dock.

b. Corridors used for traffic of mechanized carts, forklifts, and pallet-handling units.

c. Mechanical rooms.

d. Gymnasiums

4. Concealed in Ceilings and Interior Walls and Partitions: EMT.

5. Damp or Wet Locations: GRC or IMC.

6. Pathways for Optical-Fiber or Communications Cable in Spaces Used for Environmental Air: EMT.

7. Pathways for Optical-Fiber or Communications-Cable Risers in Vertical Shafts: EMT.

8. Pathways for Concealed General-Purpose Distribution of Optical-Fiber or Communications Cable: EMT.

9. Boxes and Enclosures: NEMA 250, Type 1, except use NEMA 250, Type 4 stainless steel units in institutional and commercial kitchens and damp or wet locations.

C. Minimum Pathway Size: 3/4-inch (21-mm) trade size for copper and aluminum cables, and 1 inch (25 mm) for optical-fiber cables.

D. Pathway Fittings: Compatible with pathways and suitable for use and location.

1. Rigid and Intermediate Steel Conduit: Use threaded rigid steel conduit fittings unless otherwise indicated. Comply with NEMA FB 2.10.

2. PVC Externally Coated, Rigid Steel Conduits: Use only fittings listed for use with this type of conduit. Patch and seal all joints, nicks, and scrapes in PVC coating after installing conduits and fittings. Use sealant recommended by fitting manufacturer and apply in thickness and number of coats recommended by manufacturer.

3. EMT: Use set-screw or compression, steel fittings. Comply with NEMA FB 2.10.

E. Do not install aluminum conduits, boxes, or fittings in contact with concrete or earth.

F. Install surface pathways only where indicated on Drawings.

G. Do not install nonmetallic conduit where ambient temperature exceeds 120 deg F (49 deg C).

3.2 INSTALLATION

A. Comply with the following standards for installation requirements except where requirements on Drawings or in this Section are stricter:

1. NECA 1.

2. NECA/BICSI 568.

3. TIA-569-D.

4. NECA 101

5. NECA 102.

6. NECA 105.

7. NECA 111.

B. Comply with NFPA 70 limitations for types of pathways allowed in specific occupancies and number of floors.

C. Comply with requirements in Section 078413 "Penetration Firestopping" for firestopping materials and installation for penetrations through fire-rated walls, ceilings, and assemblies.

D. Comply with requirements in Section 270529 "Hangers and Supports for Communications Systems" for hangers and supports.

E. Comply with requirements in Section 270544 "Sleeves and Sleeve Seals for Communications Pathways and Cabling" for sleeves and sleeve seals for communications.

F. Keep pathways at least 6 inches (150 mm) away from parallel runs of flues and steam or hot-water pipes. Install horizontal pathway runs above water and steam piping.

G. Complete pathway installation before starting conductor installation.

H. Arrange stub-ups so curved portions of bends are not visible above finished slab.

I. Install no more than the equivalent of two 90-degree bends in any pathway run. Support within 12 inches (300 mm) of changes in direction. Utilize long radius ells for all optical-fiber cables.

J. Conceal rigid conduit within finished walls, ceilings, and floors unless otherwise indicated. Install conduits parallel or perpendicular to building lines.

K. Support conduit within 12 inches (300 mm) of enclosures to which attached.

L. Pathways Embedded in Slabs:

1. Run conduit larger than 1-inch (27-mm) trade size, parallel or at right angles to main reinforcement. Where at right angles to reinforcement, place conduit close to slab support. Secure pathways to reinforcement at maximum 10-foot (3-m) intervals.

2. Arrange pathways to cross building expansion joints at right angles with expansion fittings. Comply with requirements for expansion joints specified in this article.

3. Arrange pathways to keep a minimum of 2 inches (50 mm) of concrete cover in all directions.

4. Do not embed threadless fittings in concrete unless specifically approved by Architect for each specific location.

5. Change from nonmetallic conduit and fittings to GRC and fittings before rising above floor.

M. Stub-ups to Above Recessed Ceilings:

1. Use EMT, IMC, or RMC for pathways.

2. Use a conduit bushing or insulated fitting to terminate stub-ups not terminated in hubs or in an enclosure.

N. Threaded Conduit Joints, Exposed to Wet, Damp, Corrosive, or Outdoor Conditions: Apply listed compound to threads of pathway and fittings before making up joints. Follow compound manufacturer's written instructions.

O. Coat field-cut threads on PVC-coated pathway with a corrosion-preventing conductive compound prior to assembly.

P. Terminate threaded conduits into threaded hubs or with locknuts on inside and outside of boxes or cabinets. Install insulated bushings on conduits terminated with locknuts.

Q. Install pathways square to the enclosure and terminate at enclosures with locknuts. Install locknuts hand tight plus one additional quarter-turn.

R. Do not rely on locknuts to penetrate nonconductive coatings on enclosures. Remove coatings in the locknut area prior to assembling conduit to enclosure, to assure a continuous ground path.

S. Cut conduit perpendicular to the length. For conduits of 2-inch (50-mm) trade size and larger, use roll cutter or a guide to ensure cut is straight and perpendicular to the length.

T. Install pull wires in empty pathways. Use polypropylene or monofilament plastic line with not less than 200-lb (90-kg) tensile strength. Leave at least 12 inches (300 mm) of slack at each end of pull wire. Secure pull wire, so it cannot fall into conduit. Cap pathways designated as spare alongside pathways in use.

U. Surface Pathways:

1. Install surface pathway for surface telecommunications outlet boxes only where indicated on Drawings.

2. Install surface pathway with a minimum 2-inch (50-mm) radius control at bend points.

3. Secure surface pathway with screws or other anchor-type devices at intervals not exceeding 48 inches (1200 mm) and with no less than two supports per straight pathway section. Support surface pathway according to manufacturer's written instructions. Tape and glue are not acceptable support methods.

V. Pathways for Optical-Fiber and Communications Cable: Install pathways, metal and nonmetallic, rigid and flexible, as follows:

1. 3/4-Inch (21-mm) Trade Size and Smaller: Install pathways in maximum lengths of 50 feet (15 m).

2. 1-Inch (25-mm) Trade Size and Larger: Install pathways in maximum lengths of 75 feet (23 m).

3. Install with a maximum of two 90-degree bends or equivalent for each length of pathway unless Drawings show stricter requirements. Separate lengths with pull or junction boxes or terminations at distribution frames or cabinets where necessary to comply with these requirements.

W. Install pathway-sealing fittings at accessible locations according to NFPA 70 and fill them with listed sealing compound. For concealed pathways, install each fitting in a flush steel box with a blank cover plate having a finish similar to that of adjacent plates or surfaces. Install pathway-sealing fittings according to NFPA 70.

X. Install devices to seal pathway interiors at accessible locations. Locate seals, so no fittings or boxes are between the seal and the following changes of environments. Seal the interior of all pathways at the following points:

1. Where conduits pass from warm to cold locations, such as boundaries of refrigerated spaces.

2. Where an underground service pathway enters a building or structure.

3. Where otherwise required by NFPA 70.

Y. Comply with manufacturer's written instructions for solvent welding PVC conduit and fittings.

Z. Expansion-Joint Fittings:

1. Install in each run of aboveground RNC that is located where environmental temperature change may exceed 30 deg F (17 deg C), and that has straight-run length that exceeds 25

feet (7.6 m). Install in each run of aboveground RMC and EMT that is located where environmental temperature change may exceed 100 deg F (55 deg C), and that has straight-run length that exceeds 100 feet (30 m).

2. Install type and quantity of fittings that accommodate temperature change listed for each of the following locations:

   a. Outdoor Locations Not Exposed to Direct Sunlight: 125 deg F (70 deg C) temperature change.

   b. Outdoor Locations Exposed to Direct Sunlight: 155 deg F (86 deg C) temperature change.

   c. Indoor Spaces Connected with Outdoors without Physical Separation: 125 deg F (70 deg C) temperature change.

   d. Attics: 135 deg F (75 deg C) temperature change.

3. Install fitting(s) that provide expansion and contraction for at least 0.00041 inch per foot of length of straight run per deg F (0.06 mm per meter of length of straight run per deg C) of temperature change for PVC conduits. Install fitting(s) that provide expansion and contraction for at least 0.000078 inch per foot of length of straight run per deg F (0.0115 mm per meter of length of straight run per deg C) of temperature change for metal conduits.

4. Install expansion fittings at all locations where conduits cross building or structure expansion joints.

5. Install each expansion-joint fitting with position, mounting, and piston setting selected according to manufacturer's written instructions for conditions at specific location at time of installation. Install conduit supports to allow for expansion movement.

AA. Hooks:

1. Size to allow a minimum of 25 percent future capacity without exceeding design capacity limits.

2. Shall be supported by dedicated support wires. Do not use ceiling grid support wire or support rods.

3. Hook spacing shall allow no more than 6 inches (150 mm) of slack. The lowest point of the cables shall be no less than 6 inches (150 mm) adjacent to ceilings, mechanical ductwork and fittings, luminaires, power conduits, power and telecommunications outlets, and other (BP-1) equipment.

4. Space hooks no more than 5 feet (1.5 m) o.c.

5. Provide a hook at each change in direction.

BB. Mount boxes at heights indicated on Drawings. If mounting heights of boxes are not individually indicated, give priority to ADA requirements. Install boxes with height measured to center of box unless otherwise indicated.

CC. Recessed Boxes in Masonry Walls: Saw-cut opening for box in center of cell of masonry block, and install box flush with surface of wall. Prepare block surface to provide a flat surface for a raintight connection between box and cover plate or supported equipment and box.

DD. Horizontally separate boxes mounted on opposite sides of walls, so they are not in the same vertical channel.

EE. Support boxes of three gangs or more from more than one side by spanning two framing members or mounting on brackets specifically designed for the purpose.

FF. Fasten junction and pull boxes to or support from building structure. Do not support boxes by conduits.

GG. Set metal floor boxes level and flush with finished floor surface.

HH. Set nonmetallic floor boxes level. Trim after installation to fit flush with finished floor surface.

3.3 INSTALLATION OF UNDERGROUND CONDUIT

A. Direct-Buried Conduit:

1. Excavate trench bottom to provide firm and uniform support for conduit. Prepare trench bottom as specified in Section 312000 "Earth Moving" for pipe of less than 6 inches (150 mm) in nominal diameter.

2. Install backfill as specified in Section 312000 "Earth Moving."

3. After installing conduit, backfill and compact. Start at tie-in point, and work toward end of conduit run, leaving conduit at end of run free to move with expansion and contraction as temperature changes during this process. Firmly hand tamp backfill around conduit to provide maximum supporting strength. After placing controlled backfill to within 12 inches (300 mm) of finished grade, make final conduit connection at end of run and complete backfilling with normal compaction as specified in Section 312000 "Earth Moving."

4. Install manufactured duct elbows for stub-ups at poles and equipment and at building entrances through floor unless otherwise indicated. Encase elbows for stub-up ducts throughout length of elbow.

5. Install manufactured rigid steel conduit elbows for stub-ups at poles and equipment and at building entrances through floor.

a. Couple steel conduits to ducts with adapters designed for this purpose, and encase coupling with 3 inches (75 mm) of concrete around conduit for a minimum of 12 inches (300 mm) on each side of the coupling.

b. For stub-ups at equipment mounted on outdoor concrete bases and where conduits penetrate building foundations, extend steel conduit horizontally a minimum of 60 inches (1500 mm) from edge of foundation or equipment base. Install insulated grounding bushings on terminations at equipment.

6. Warning Planks: Bury warning planks approximately 12 inches (300 mm) above direct-buried conduits, but a minimum of 6 inches (150 mm) below grade. Align planks along centerline of conduit.

7. Underground Warning Tape: Comply with requirements in Section 270553 "Identification for Communications Systems."

3.4 INSTALLATION OF UNDERGROUND HANDHOLES AND BOXES

A. Install handholes and boxes level and plumb and with orientation and depth coordinated with connecting conduits to minimize bends and deflections required for proper entrances.

B. Unless otherwise indicated, support units on a level bed of crushed stone or gravel, graded from 1/2-inch (12.5-mm) sieve to No. 4 (4.75-mm) sieve and compacted to same density as adjacent undisturbed earth.

C. Elevation: In paved areas, set so cover surface will be flush with finished grade. Set covers of other enclosures 1 inch (25 mm) above finished grade.

D. Install handholes with bottom below frost line, 36” below grade.

E. Install removable hardware, including pulling eyes, cable stanchions, cable arms, and insulators, as required for installation and support of cables and conductors and as indicated. Select arm lengths to be long enough to provide spare space for future cables, but short enough to preserve adequate working clearances in enclosure.

F. Field cut openings for conduits according to enclosure manufacturer's written instructions. Cut wall of enclosure with a tool designed for material to be cut. Size holes for terminating fittings to be used, and seal around penetrations after fittings are installed.

3.5 SLEEVE AND SLEEVE-SEAL INSTALLATION FOR COMMUNICATIONS PENETRATIONS

A. Install sleeves and sleeve seals at penetrations of exterior floor and wall assemblies. Comply with requirements in Section 270544 "Sleeves and Sleeve Seals for Communications Pathways and Cabling."

3.6 FIRESTOPPING

A. Install firestopping at penetrations of fire-rated floor and wall assemblies. Comply with requirements in Section 078413 "Penetration Firestopping."

3.7 PROTECTION

A. Protect coatings, finishes, and cabinets from damage or deterioration.

1. Repair damage to galvanized finishes with zinc-rich paint recommended by manufacturer.

2. Repair damage to PVC coatings or paint finishes with matching touchup coating recommended by manufacturer.

END OF SECTION 270528

SECTION 270529 - HANGERS AND SUPPORTS 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. Steel slotted support systems for communication raceways.
2. Aluminum slotted support systems for communication raceways.
3. Nonmetallic slotted support systems for communication raceways.
4. Conduit and cable support devices.
5. Support for conductors in vertical conduit.
6. Structural steel for fabricated supports and restraints.
7. Mounting, anchoring, and attachment components, including powder-actuated fasteners, mechanical expansion anchors, concrete inserts, clamps, through bolts, toggle bolts, and hanger rods.
8. Fabricated metal equipment support assemblies.

B. Related Requirements:

1. Section 270548 "Seismic Controls for Communications Systems" for products and installation requirements necessary for compliance with seismic criteria.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for the following:
    a. Slotted support systems, hardware, and accessories.
    b. Clamps.
    c. Hangers.
    d. Sockets.
    e. Eye nuts.
    f. Fasteners.

g. Anchors.

h. Saddles.

i. Brackets.

2. Include rated capacities and furnished specialties and accessories.

B. Shop Drawings: Signed and sealed by a qualified professional engineer. For fabrication and installation details for communications hangers and support systems.

1. Trapeze hangers. Include product data for components.

2. Steel slotted-channel systems.

3. Aluminum slotted-channel systems.

4. Nonmetallic slotted-channel systems.

5. Equipment supports.

6. Vibration Isolation Base Details: Detail fabrication, including anchorages and attachments to structure and to supported equipment. Include adjustable motor bases, rails, and frames for equipment mounting.

C. Delegated-Design Submittal: For hangers and supports for communications systems.

1. Include design calculations and details of trapeze hangers.

2. Include design calculations for seismic restraints.

1.4 INFORMATIONAL SUBMITTALS

A. Coordination Drawings: Reflected ceiling plan(s) and other details, drawn to scale, on which the following items are shown and coordinated with each other, using input from installers of the items involved:

1. Suspended ceiling components.

2. Ductwork, piping, fittings, and supports.

3. Structural members to which hangers and supports will be attached.

4. Size and location of initial access modules for acoustical tile.

5. Items penetrating finished ceiling, including the following:

a. Luminaires.

b. Air outlets and inlets.

c. Speakers.

d. Sprinklers.

e. Access panels.

f. Projectors.

B. Seismic Qualification Data: Certificates, for hangers and supports for communications equipment and systems, accessories, and components, from manufacturer.

1. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.

2. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.

3. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.

C. Welding certificates.

1.5 QUALITY ASSURANCE

A. Welding Qualifications: Qualify procedures and personnel according to AWS D1.1/D1.1M.

B. Welding Qualifications: Qualify procedures and personnel according to the following:

1. AWS D1.1/D1.1M.

2. AWS D1.2/D1.2M.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Delegated Design: Engage a qualified professional engineer, as defined in Section 014000 "Quality Requirements," to design hanger and support system.

B. Seismic Performance: Hangers and supports shall withstand the effects of earthquake motions determined according to ASCE/SEI 7.

1. The term "withstand" means "the supported equipment and systems will remain in place without separation of any parts when subjected to the seismic forces specified and the system will be fully operational after the seismic event."

2. Component Importance Factor: 1.5.

C. Surface-Burning Characteristics: Comply with ASTM E84; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.

1. Flame Rating: Class 1.

2. Self-extinguishing according to ASTM D635.

2.2 SUPPORT, ANCHORAGE, AND ATTACHMENT COMPONENTS

A. Steel Slotted Support Systems: Preformed steel channels and angles with minimum 13/32-inch- (10-mm-) diameter holes at a maximum of 8 inches (200 mm) o.c. in at least one surface.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Allied Tube & Conduit; a part of Atkore International.

b. B-line, an Eaton business.

c. CADDY; a brand of nVent.

d. Gripple Inc.

e. GS Metals Corp.

f. Haydon Corporation.

g. Metal Ties Innovation.

h. MIRO Industries.

i. Thomas & Betts Corporation; A Member of the ABB Group.

j. Unistrut; Part of Atkore International.

2. Standard: Comply with MFMA-4 factory-fabricated components for field assembly.

3. Material for Channel, Fittings, and Accessories: Galvanized steel.

4. Retain first option below to allow Contractor to select size of slotted support system.

5. Channel Width: Selected for applicable load criteria.

6. Metallic Coatings: Hot-dip galvanized after fabrication and applied according to MFMA-4.

7. Nonmetallic Coatings: Manufacturer's standard PVC, polyurethane, or polyester coating applied according to MFMA-4.

8. Painted Coatings: Manufacturer's standard painted coating applied according to MFMA-4.

9. Protect finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.

10. Channel Dimensions: Selected for applicable load criteria.

B. Aluminum Slotted Support Systems: Extruded aluminum channels and angles with minimum 13/32-inch- (10-mm-) diameter holes at a maximum of 8 inches (200 mm) o.c. in at least one surface.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    a. Cooper Industries, Inc.
    b. Flex-Strut Inc.
    c. Haydon Corporation.
    d. MKT Metal Manufacturing.
    e. Thomas & Betts Corporation; A Member of the ABB Group.
    f. Unistrut; Part of Atkore International.
2. Standard: Comply with MFMA-4 factory-fabricated components for field assembly.
3. Channel Material: 6063-T6 aluminum alloy.
4. Fittings and Accessories Material: 5052-H32 aluminum alloy.
5. Channel Width: Selected for applicable load criteria.
6. Retain one of or both "Nonmetallic Coatings" and "Painted Coatings" subparagraphs below. Coordinate with the appropriate coating or painting Specification Section.
7. Nonmetallic Coatings: Manufacturer's standard PVC, polyurethane, or polyester coating applied according to MFMA-4.
8. Painted Coatings: Manufacturer's standard painted coating applied according to MFMA-4.
9. Protect finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.
10. Channel Dimensions: Selected for applicable load criteria.

C. Conduit and Cable Support Devices: Steel] clamps, hangers, and associated fittings, designed for types and sizes of raceway or cable to be supported.

D. Support for Conductors in Vertical Conduit: Factory-fabricated assembly consisting of threaded body and insulating wedging plug or plugs for nonarmored communications conductors or cables in riser conduits. Plugs shall have number, size, and shape of conductor gripping pieces as required to suit individual conductors or cables supported. Body shall be made of malleable iron.

E. Structural Steel for Fabricated Supports and Restraints: ASTM A36/A36M steel plates, shapes, and bars; black and galvanized.

F. Mounting, Anchoring, and Attachment Components: Items for fastening electrical items or their supports to building surfaces include the following:

1. Powder-Actuated Fasteners: Threaded-steel stud for use in hardened portland cement concrete, steel, or wood, with tension, shear, and pullout capacities appropriate for supported loads and building materials where used.

    a. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

        1) Hilti, Inc.

        2) ITW Ramset/Red Head; Illinois Tool Works, Inc.

        3) MKT Fastening, LLC.

        4) Simpson Strong-Tie Co., Inc.

2. Mechanical-Expansion Anchors: Insert-wedge-type stainless steel for use in hardened portland cement concrete, with tension, shear, and pullout capacities appropriate for supported loads and building materials where used.

    a. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

        1) B-line, an Eaton business.

        2) Empire Tool and Manufacturing Co., Inc.

        3) Hilti, Inc.

        4) ITW Ramset/Red Head; Illinois Tool Works, Inc.

        5) MKT Fastening, LLC.

3. Concrete Inserts: Steel or malleable-iron, slotted support system units are similar to MSS Type 18 units and comply with MFMA-4 or MSS SP-58.

4. Clamps for Attachment to Steel Structural Elements: MSS SP-58 units are suitable for attached structural element.

5. Through Bolts: Structural type, hex head, and high strength. Comply with ASTM F3125/F3125M,Grade A325 (Grade A325M).

6. Toggle Bolts: Stainless-steel springhead type.

7. Hanger Rods: Threaded steel.

2.3 FABRICATED METAL EQUIPMENT SUPPORT ASSEMBLIES

A. Description: Welded or bolted structural-steel shapes, shop or field fabricated to fit dimensions of supported equipment.

B. Materials: Comply with requirements in Section 055000 "Metal Fabrications" for steel shapes and plates.

PART 3 - EXECUTION

3.1 APPLICATION

A. Comply with the following standards for application and installation requirements of hangers and supports, except where requirements on Drawings or in this Section are stricter:

1. NECA 1.

2. NECA/BICSI 568.

3. TIA-569-D.

4. NECA 101.

5. NECA 102.

6. NECA 105.

7. NECA 111.

B. Comply with requirements in Section 078413 "Penetration Firestopping" for firestopping materials and installation for penetrations through fire-rated walls, ceilings, and assemblies.

C. Comply with requirements for pathways specified in Section 270528 "Pathways for Communications Systems."

D. Maximum Support Spacing and Minimum Hanger Rod Size for Raceway: Space supports for EMTs, IMCs, and RMCs as scheduled in NECA 1, where its Table 1 lists maximum spacings that are less than those stated in NFPA 70. Minimum rod size shall be 1/4 inch (6 mm) in diameter.

E. Multiple Raceways or Cables: Install trapeze-type supports fabricated with steel slotted 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 two-bolt conduit clamps.

F. Spring-steel clamps designed for supporting single conduits without bolts may be used for 1-1/2-inch (38-mm) and smaller raceways serving branch circuits and communication systems above suspended ceilings and for fastening raceways to trapeze supports.

3.2 SUPPORT INSTALLATION

A. Raceway Support Methods: In addition to methods described in NECA 1, EMT IMC and RMC may be supported by openings through structure members, according to NFPA 70.

B. Strength of Support Assemblies: Where not indicated, select sizes of components, so strength will be adequate to carry present and future static loads within specified loading limits. Minimum static design load used for strength determination shall be weight of supported components plus 200 lb (90 kg).

C. Mounting and Anchorage of Surface-Mounted Equipment and Components: Anchor and fasten communications 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: Use approved toggle-type bolts on hollow masonry units and expansion anchor fasteners on solid masonry units.

4. To Existing Concrete: Use 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 SP-58, Type 19, 21, 23, 25, or 27), complying with MSS SP-69.

7. To Light Steel: Sheet metal screws.

8. Items Mounted on Hollow Walls and Nonstructural Building Surfaces: Mount cabinets, panelboards, disconnect switches, control enclosures, pull and junction boxes, transformers, and other devices on slotted-channel racks attached to substrate by means that comply with seismic-restraint strength and anchorage requirements.

D. Drill holes for expansion anchors in concrete at locations and to depths that avoid the need for reinforcing bars.

3.3 INSTALLATION OF FABRICATED METAL SUPPORTS

A. Comply with installation requirements in Section 055000 "Metal Fabrications" for site-fabricated metal supports.

B. Cut, fit, and place miscellaneous metal supports accurately in location, alignment, and elevation to support and anchor communications materials and equipment.

C. Field Welding: Comply with AWS D1.1/D1.1M.

3.4 PAINTING

A. Touchup: Clean field welds and abraded areas of shop paint. Paint exposed areas immediately after erecting hangers and supports. Use same materials as used for shop painting. Comply with SSPC-PA 1 requirements for touching up field-painted surfaces.

1. Apply paint by brush or spray to provide minimum dry film thickness of 2.0 mils (0.05 mm).

B. Touchup: Comply with requirements in Section 099113 "Exterior Painting" Section 099123 "Interior Painting" and Section 099600 "High-Performance Coatings" for cleaning and touchup

painting of field welds, bolted connections, and abraded areas of shop paint on miscellaneous metal.

C. Galvanized Surfaces: Clean welds, bolted connections, and abraded areas, and apply galvanizing-repair paint to comply with ASTM A780.

END OF SECTION 270529

SECTION 270544 - SLEEVES AND SLEEVE SEALS FOR COMMUNICATIONS PATHWAYS AND CABLING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Sleeves for pathway and cable penetration of non-fire-rated construction walls and floors.
2. Sleeve-seal systems.
3. Sleeve-seal fittings.
4. Grout.
5. Silicone sealants.

B. Related Requirements:

1. Section 078413 "Penetration Firestopping" for penetration firestopping installed in fire-resistance-rated walls, horizontal assemblies, and smoke barriers, with and without penetrating items.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

PART 2 - PRODUCTS

2.1 SLEEVES

A. Wall Sleeves:

1. Steel Pipe Sleeves: ASTM A53/A53M, Type E, Grade B, Schedule 40, zinc coated, plain ends.
2. Cast-Iron Pipe Sleeves: Cast or fabricated "wall pipe," equivalent to ductile-iron pressure pipe, with plain ends and integral waterstop unless otherwise indicated.

B. Sleeves for Conduits Penetrating Non-Fire-Rated Gypsum Board Assemblies: Galvanized-steel sheet; 0.0239-inch (0.6-mm) minimum thickness; round tube closed with welded longitudinal joint, with tabs for screw-fastening the sleeve to the board.

C. PVC-Pipe Sleeves: ASTM D1785, Schedule 40.

D. Molded-PVC Sleeves: With nailing flange for attaching to wooden forms.

E. Molded-PE or -PP Sleeves: Removable, tapered-cup shaped, and smooth outer surface with nailing flange for attaching to wooden forms.

F. Sleeves for Rectangular Openings:

1. Material: Galvanized-steel sheet.

2. Minimum Metal Thickness:

a. For sleeve cross-section rectangle perimeter less than 50 inches (1270 mm) and with no side larger than 16 inches (400 mm), thickness shall be 0.052 inch (1.3 mm).

b. For sleeve cross-section rectangle perimeter 50 inches (1270 mm) or more and one or more sides larger than 16 inches (400 mm), thickness shall be 0.138 inch (3.5 mm).

2.2 SLEEVE-SEAL SYSTEMS

A. Description: Modular sealing device, designed for field assembly, to fill annular space between sleeve and pathway or cable.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Advance Products & Systems, Inc.

b. CALPICO, Inc.

c. HOLDRITE; Reliance Worldwide Company.

d. Metraflex Company (The).

e. Pipeline Seal and Insulator, Inc.

f. Proco Products, Inc.

2. Sealing Elements: EPDM rubber interlocking links shaped to fit surface of pipe. Include type and number required for pipe material and size of pipe.

3. Pressure Plates: Stainless steel.

4. Connecting Bolts and Nuts: Stainless steel of length required to secure pressure plates to sealing elements.

2.3 SLEEVE-SEAL FITTINGS

A. Description: Manufactured plastic, sleeve-type, waterstop assembly made for embedding in concrete slab or wall. Unit shall have plastic or rubber waterstop collar with center opening to match piping OD.

1. Manufacturers: Subject to compliance with requirements, provide products by the following:

a. HOLDRITE; Reliance Worldwide Company.

2.4 GROUT

A. Description: Nonshrink; recommended for interior and exterior sealing openings in non-fire-rated walls or floors.

B. Standard: ASTM C1107/C1107M, Grade B, post-hardening and volume-adjusting, dry, hydraulic-cement grout.

C. Design Mix: 5000-psi (34.5-MPa), 28-day compressive strength.

D. Packaging: Premixed and factory packaged.

2.5 SILICONE SEALANTS

A. Silicone Sealants: Single-component, silicone-based, neutral-curing elastomeric sealants of grade indicated below.

1. Grade: Pourable (self-leveling) formulation for openings in floors and other horizontal surfaces that are not fire rated.

B. Silicone Foams: Multicomponent, silicone-based liquid elastomers that, when mixed, expand and cure in place to produce a flexible, nonshrinking foam.

PART 3 - EXECUTION

3.1 SLEEVE INSTALLATION FOR NON-FIRE-RATED ELECTRICAL PENETRATIONS

A. Comply with NECA 1.

B. Comply with NEMA VE 2 for cable tray and cable penetrations.

C. Sleeves for Conduits Penetrating Above-Grade Non-Fire-Rated Concrete and Masonry-Unit Floors and Walls:

1. Interior Penetrations of Non-Fire-Rated Walls and Floors:

a. Seal annular space between sleeve and pathway or cable, using joint sealant appropriate for size, depth, and location of joint. Comply with requirements in Section 079200 "Joint Sealants."

b. Seal space outside of sleeves with mortar or grout. Pack sealing material solidly between sleeve and wall so no voids remain. Tool exposed surfaces smooth; protect material while curing.

2. Use pipe sleeves unless penetration arrangement requires rectangular sleeved opening.

3. Size pipe sleeves to provide 1/4-inch (6.4-mm) annular clear space between sleeve and pathway or cable unless sleeve seal is to be installed.

4. Install sleeves for wall penetrations unless core-drilled holes or formed openings are used. Install sleeves during erection of walls. Cut sleeves to length for mounting flush with both surfaces of walls. Deburr after cutting.

5. Install sleeves for floor penetrations. Extend sleeves installed in floors 2 inches (50 mm) above finished floor level. Install sleeves during erection of floors.

D. Sleeves for Conduits Penetrating Non-Fire-Rated Gypsum Board Assemblies:

1. Use circular metal sleeves unless penetration arrangement requires rectangular sleeved opening.

2. Seal space outside of sleeves with approved joint compound for gypsum board assemblies.

E. Roof-Penetration Sleeves: Seal penetration of individual pathways and cables with flexible boot-type flashing units applied in coordination with roofing work.

F. Aboveground, Exterior-Wall Penetrations: Seal penetrations using steel pipe sleeves and mechanical sleeve seals. Select sleeve size to allow for 1-inch (25-mm) annular clear space between pipe and sleeve for installing mechanical sleeve seals.

G. Underground, Exterior-Wall and Floor Penetrations: Install cast-iron pipe sleeves. Size sleeves to allow for 1-inch (25-mm) annular clear space between pathway or cable and sleeve for installing sleeve-seal system.

3.2 SLEEVE-SEAL-SYSTEM INSTALLATION

A. Install sleeve-seal systems in sleeves in exterior concrete walls and slabs-on-grade at pathway entries into building.

B. Install type and number of sealing elements recommended by manufacturer for pathway or cable material and size. Position pathway or cable in center of sleeve. Assemble mechanical sleeve seals and install in annular space between pathway or cable and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make watertight seal.

3.3 SLEEVE-SEAL-FITTING INSTALLATION

A. Install sleeve-seal fittings in new walls and slabs as they are constructed.

B. Assemble fitting components of length to be flush with both surfaces of concrete slabs and walls. Position waterstop flange to be centered in concrete slab or wall.

C. Secure nailing flanges to concrete forms.

D. Using grout, seal the space around outside of sleeve-seal fittings.

END OF SECTION 270544

SECTION 270548.16 - SEISMIC CONTROLS 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. Restraint channel bracings.
2. Restraint cables.
3. Seismic-restraint accessories.
4. Mechanical anchor bolts.
5. Adhesive anchor bolts.

B. Related Requirements:

1. Section 270528.29 "Hangers and Supports for Communications Systems" for commonly used supports and installation requirements.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Illustrate and indicate style, material, strength, fastening provision, and finish for each type and size of seismic-restraint component used.
    a. Tabulate types and sizes of seismic restraints, complete with report numbers and rated strength in tension and shear as evaluated by an evaluation service member of ICC-ES.
    b. Annotate to indicate application of each product submitted and compliance with requirements.

B. Delegated-Design Submittal: For each seismic-restraint device.

1. Include design calculations and details for selecting seismic restraints complying with performance requirements, design criteria, and analysis data signed and sealed by the qualified professional engineer responsible for their preparation.
2. Design Calculations: Calculate static and dynamic loading caused by equipment weight, operation, and seismic and wind forces required to select seismic and wind restraints and for designing vibration isolation bases.

a. Coordinate design calculations with wind load calculations required for equipment mounted outdoors. Comply with requirements in other Sections for equipment mounted outdoors.

3. Seismic- and Wind-Restraint Details:

a. Design Analysis: To support selection and arrangement of seismic and wind restraints. Include calculations of combined tensile and shear loads.

b. Details: Indicate fabrication and arrangement. Detail attachments of restraints to the restrained items and to the structure. Show attachment locations, methods, and spacings. Identify components, list their strengths, and indicate directions and values of forces transmitted to the structure during seismic events. Indicate association with vibration isolation devices.

c. Coordinate seismic-restraint and vibration isolation details with wind-restraint details required for equipment mounted outdoors. Comply with requirements in other Sections for equipment mounted outdoors.

d. Preapproval and Evaluation Documentation: By an evaluation service member of ICC-ES, showing maximum ratings of restraint items and the basis for approval (tests or calculations).

1.4 INFORMATIONAL SUBMITTALS

A. Coordination Drawings: Show coordination of seismic bracing for electrical components with other systems and equipment in the vicinity, including other supports and seismic restraints. Communications components include:

1. Uninterruptible power supplies.

2. Racks.

3. Frames.

4. Cabinets.

5. Cable tray.

6. Conduits.

B. Qualification Data: For professional engineer.

C. Welding certificates.

D. Field quality-control reports.

1.5 QUALITY ASSURANCE

A. Testing Agency Qualifications: An independent agency, with the experience and capability to conduct the testing indicated and that is acceptable to authorities having jurisdiction.

B. Comply with seismic-restraint requirements in the IBC unless requirements in this Section are more stringent.

C. Welding Qualifications: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."

D. Seismic-restraint devices shall have horizontal and vertical load testing and analysis. They shall bear anchorage preapproval from OSHPD in addition to preapproval, showing maximum seismic-restraint ratings, by ICC-ES or another agency acceptable to authorities having jurisdiction. Ratings based on independent testing are preferred to ratings based on calculations. If preapproved ratings are not available, submittals based on independent testing are preferred. Calculations (including combining shear and tensile loads) that support seismic-restraint designs must be signed and sealed by a qualified professional engineer.

E. Comply with NFPA 70.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Wind-Restraint Loading:

1. Basic Wind Speed: 105.

2. Building Classification Category: [III].

3. Minimum 10 lb/sq. ft. (48.8 kg/sq. m) multiplied by maximum area of component projected on vertical plane normal to wind direction and 45 degrees either side of normal.

B. Seismic-Restraint Loading:

1. Site Class as Defined in the IBC: D.

2. Assigned Seismic Use Group or Building Category as Defined in the IBC: [III].

a. Component Importance Factor: 1.5.

b. Component Response Modification Factor: 1.5.

c. Component Amplification Factor: 2.5.

3. Design Spectral Response Acceleration at Short Periods (0.2 Second):

4. Design Spectral Response Acceleration at 1.0-Second Period:

2.2 RESTRAINT CHANNEL BRACINGS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. B-line, an Eaton business.

2. Hilti, Inc.

3. Mason Industries, Inc.

4. Unistrut; Part of Atkore International.

B. Description: MFMA-4, shop- or field-fabricated bracing assembly made of slotted steel channels with accessories for attachment to braced component at one end and to building structure at the other end, with other matching components, and with corrosion-resistant coating; rated in tension, compression, and torsion forces.

2.3 RESTRAINT CABLES

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. CADDY; a brand of nVent.

2. Gripple Inc.

3. Kinetics Noise Control, Inc.

4. Vibration Mountings & Controls, Inc.

B. Restraint Cables: ASTM A492 stainless-steel cables. End connections made of steel assemblies with thimbles, brackets, swivel, and bolts designed for restraining cable service; with a minimum of two clamping bolts for cable engagement.

2.4 SEISMIC-RESTRAINT ACCESSORIES

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. B-line, an Eaton business.

2. Kinetics Noise Control, Inc.

3. Mason Industries, Inc.

B. Hanger-Rod Stiffener: Reinforcing steel angle clamped to hanger rod.

C. Hinged and Swivel Brace Attachments: Multifunctional steel connectors for attaching hangers to rigid channel bracings and restraint cables.

D. Bushings for Floor-Mounted Equipment Anchor Bolts: Neoprene bushings designed for rigid equipment mountings and matched to type and size of anchor bolts and studs.

E. Bushing Assemblies for Wall-Mounted Equipment Anchorage: Assemblies of neoprene elements and steel sleeves designed for rigid equipment mountings and matched to type and size of attachment devices used.

F. Resilient Isolation Washers and Bushings: One-piece, molded, oil- and water-resistant neoprene, with a flat washer face.

2.5 MECHANICAL ANCHOR BOLTS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. B-line, an Eaton business.

2. Hilti, Inc.

3. Kinetics Noise Control, Inc.

4. Mason Industries, Inc.

B. Mechanical Anchor Bolts: Drilled-in and stud-wedge or female-wedge type in zinc-coated steel for interior applications and stainless steel for exterior applications. Select anchor bolts with strength required for anchor and as tested according to ASTM E488.

2.6 ADHESIVE ANCHOR BOLTS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Hilti, Inc.

2. Kinetics Noise Control, Inc.

3. Mason Industries, Inc.

B. Adhesive Anchor Bolts: Drilled-in and capsule anchor system containing PVC or urethane methacrylate-based resin and accelerator, or injected polymer or hybrid mortar adhesive. Provide anchor bolts and hardware with zinc-coated steel for interior applications and stainless steel for exterior applications. Select anchor bolts with strength required for anchor and as tested according to ASTM E488.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas and equipment to receive vibration isolation and seismic-control devices for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.

B. Examine roughing-in for reinforcement and cast-in-place anchors to verify actual locations before installation.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 APPLICATIONS

A. Multiple Raceways or Cables: Secure raceways and cables to trapeze member with clamps approved for application by an evaluation service member of ICC-ES.

B. Hanger-Rod Stiffeners: Install hanger-rod stiffeners where indicated or scheduled on Drawings to receive them and where required to prevent buckling of hanger rods caused by seismic forces.

C. Strength of Support and Seismic-Restraint Assemblies: Where not indicated, select sizes of components so strength will be adequate to carry present and future static and seismic loads within specified loading limits.

3.3 SEISMIC-RESTRAINT DEVICE INSTALLATION

A. Coordinate the location of embedded connection hardware with supported equipment attachment and mounting points and with requirements for concrete reinforcement and formwork specified in Section 033000 "Cast-in-Place Concrete."

B. Equipment and Hanger Restraints:

1. Install resilient, bolt-isolation washers on equipment anchor bolts where clearance between anchor and adjacent surface exceeds 0.125 inch (3.2 mm).

2. Install seismic-restraint devices using methods approved by an evaluation service member of ICC-ES providing required submittals for component.

C. Install cables so they do not bend across edges of adjacent equipment or building structure.

D. 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.

E. Attachment to Structure: If specific attachment is not indicated, anchor bracing to structure at flanges of beams, at upper truss chords of bar joists, or at concrete members.

F. Drilled-in Anchors:

1. Identify position of reinforcing steel and other embedded items prior to drilling holes for anchors. Do not damage existing reinforcing or embedded items during coring or drilling. Notify the structural engineer if reinforcing steel or other embedded items are encountered during drilling. Locate and avoid prestressed tendons, electrical and telecommunications conduit, and gas lines.

2. Do not drill holes in concrete or masonry until concrete, mortar, or grout has achieved full design strength.

3. Wedge Anchors: Protect threads from damage during anchor installation. Heavy-duty sleeve anchors shall be installed with sleeve fully engaged in the structural element to which anchor is to be fastened.

4. Adhesive Anchors: Clean holes to remove loose material and drilling dust prior to installation of adhesive. Place adhesive in holes proceeding from the bottom of the hole and progressing toward the surface in such a manner as to avoid introduction of air pockets in the adhesive.

5. Set anchors to manufacturer's recommended torque using a torque wrench.

6. Install zinc-coated steel anchors for interior and stainless-steel anchors for exterior applications.

3.4 ACCOMMODATION OF DIFFERENTIAL SEISMIC MOTION

A. Install flexible connections in runs of raceways, cables, wireways, cable trays, and busways where they cross seismic joints, where adjacent sections or branches are supported by different structural elements, and where connection is terminated to equipment that is anchored to a different structural element from the one supporting them as they approach equipment.

3.5 FIELD QUALITY CONTROL

A. Testing Agency: Engage a qualified testing agency to perform tests and inspections.

B. Perform the following tests and inspections with the assistance of a factory-authorized service representative:

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.

C. Seismic controls will be considered defective if they do not pass tests and inspections.

D. Prepare test and inspection reports.

3.6 ADJUSTING

A. Adjust restraints to permit free movement of equipment within normal mode of operation.

END OF SECTION 270548.16

SECTION 27 1500 – COMMUNICATIONS HORIZONTAL CABLING

1. Part 1 - GENERAL

1.1. SUMMARY

1) A horizontal distribution cabling system is the portion of the telecommunications cabling system that extends from work area telecommunications outlet/connector to horizontal cross-connect in the telecommunications Room.

Furnish, install, and test communications horizontal cabling as described in Contract Documents including but is not limited to the following:

1. Published Standards and References
2. Submittals
3. Quality Assurance and Warranty
4. Work Areas
5. Horizontal Pathways
6. Horizontal Cabling Systems
7. Backbone Pathways
8. Campus Cabling
9. Telecommunication Spaces
10. Firestopping
11. Bonding and Grounding
12. Power Distribution
13. Field Testing
14. CATV
15. Building Automation
16. Wireless
17. Outside Plant

1.2. REFERENCES

1.2.1. Association Publications:

1) British Standards Institution (BSI): BS EN 50310: 2010, 'Application of Equipotential Bonding and Earthing in Buildings with Information Technology Equipment.
2) Building Industry Consulting Service International (BISCI): Information Transport Systems Installation Methods Manual (ITSIMM) (7th Edition).
3) Telecommunications Distribution Methods Manual (TDMM) (14th Edition) reviewed by RCDD.
4) Institute of Electrical and Electronics Engineers (IEEE): 1100-2005 Emerald Book, "Recommended Practice for Powering and Grounding Electric Equipment".
5) Telecommunications Industry Association: TSB-162-B, 'Telecommunication Cabling Guidelines for Wireless Access Points' (February 2021).

1.2.2. Reference Standards:

1) American National Standards Institute/Telecommunications Industry Association:
   a) ANSI/J-STD-607-A (October 2002), 'Commercial Building Grounding (Earthing) and Bonding Requirements for Telecommunications.'

b) ANSI/TIA-758-B-2012, 'Customer-Owned Outside Plant Telecommunication Infrastructure Standard.'
c) ANSI/TIA-568.0-D (September 2015), 'Generic Telecommunications Cabling for Customer Premise.'
d) ANSI/TIA-568.1-D (September 2015), 'Commercial Building Telecommunications Cabling Standard.'
e) ANSI/TIA-568-C.2-D (September 2018), 'Balanced Twisted-Pair Telecommunications Cabling and Components Standard.'
f) ANSI/TIA-569-D-2015, 'Commercial Building Standard for Telecommunications Pathways and Spaces.'
g) ANSI/TIA-606-C (June 2017), 'Administration Standard for Commercial Telecommunications Infrastructure.'
h) ANSI/TIA-607-D (July 2019) Generic Telecommunications Bonding and Grounding (Earthing) for Customer Premises
i) ANSI/TIA-942-2-B (July 2017), 'Telecommunications Infrastructure Standard for Data Centers.'
j) ANSI/TIA-1152-A-2016, 'Requirements for Field Test Instruments and Measurements for Balanced "Twisted –Pair" Cabling.'

2) Institute of Electrical and Electronics Engineers (IEEE):
   a) *802.3-2009 IEEE Standard for Information Technology— Part 3*: Carrier Sense Multiple Access with Collision Detection (CSMA/CD) Access Method and Physical Layer Specifications - Amendment 2: Ethernet Organizationally Specific Type, Length, Value (TLVs).
3) International Electrotechnical Commission:
   a) *IEC 60603-7:2008, 'Connectors for electronic equipment – Part 7* 'Detail specification for 8-way, unshielded, free and fixed connectors.'
4) International Organization for Standardization:
   a) *ISO 11801:2002/Amd 2:2010*, 'Information Technology-Generic Cabling for Customer Premises.
5) National Fire Protection Association:
   a) *NFPA 70–2020*, 'National Electrical Code.'

1.3. SUBMITTALS

Submittals must be provided to and approved by ICS Layer-1 Cable Plant Engineers at Layer1Engineering@churchofjesuschrist.org

1.3.1. Action Submittals (submit for engineering approval before project installation begins)

1) Product Data: Provide Manufacturer's installation instructions and descriptive information for each piece of equipment or product.
2) Shop Drawings: Provide drawings for telecommunication room layouts and rack elevation schemes.

1.3.2. Informational Submittals (submit for engineering approval before project installation begins)

1) Certifications:
   a) Provide company certificate showing partnership with the manufacturer (PCI certification-Panduit, CSI certification-CommScope, CSV certification-Belden, NPI certification Corning).
   b) Provide qualification statement letters from manufacturer certifying level of training and experience of installer.

2) Identification and labeling Scheme:

a) Submit labeling scheme following Church Headquarters Facilities labeling standard for engineering approval before labeling begins.
   i) Clearly identify all components of the system: racks, cables, panels, and outlets.
   ii) Telecommunication Room (TR) – Each TR room in the facility shall have a unique number. Use existing room numbers for existing facilities. For new TR rooms coordinate numbering with ICS Layer-1 Cable Plant Engineers at *Layer1Engineering@churchofjesuschrist.org*
   iii) Racks (R#) – Each rack in the TR shall have a unique one-digit number. Use existing rack numbers in existing TRs. For new TRs identify each rack with a one-digit number starting at "Rack 1".
   iv) Patch Panels (P#) – Each patch panel in a rack shall have a unique one-digit number. Continue existing patch panel numbering sequence in existing racks. For new patch panels in a new rack label each panel with a one-digit number starting at "Panel 1" for the topmost panel in the rack then sequentially down the rack.
   v) Station End outlets – label both cable and face plate or surface mounted box with a unique identifier including the source of cable by identifying the Telecommunication Room(TR)/Rack Number(RN)/Patch Panel(PP)/Port Number(PN). Example: 104/R1/P3/27

3) Tests and Evaluation Reports:
   a) Submit documentation within ten (10) working days of completion of each testing phase. This is inclusive of all test results and record drawings.
   b) Draft drawings may include annotations done by hand. Final copies of all drawings shall be submitted within thirty (30) working days of completion of each testing phase.
   c) At the request of Consulting Engineer, provide copies of the original test results.

4) Field Quality Control Submittals: The Design Professional will provide floor plans in paper and electronic formats on which record documentation information can be recorded by the installation contractor.

1.3.3. Closeout Submittals

1) Operations and Maintenance Manual:
   a) Include the following information in electronic PDF format:
      i) Operations and Maintenance Data: Provide operating and maintenance cut sheets for all equipment and products used.
      ii) Warranty Documentation: Provide a final, executed copy of all Warranties. Provide hard copies to ICS Layer-1 Cable Engineer in addition to the electronic PDF. *Layer1Engineering@churchofjesuschrist.org*
      iii) Record Documentation:
         (1) Tests and evaluation reports
         (2) As-built Documentation:
            (a) Plans showing MDF/IDF/TR locations with correct room numbers.
            (b) Plans showing cable routes and outlet locations.
            (c) Identification and labeling system.
            (d) Provide a patch panel schedule both in PDF format and Excel file format.
            (e) Provide CAD Revit files of as-built plans in addition to the electronic PDF files.
            (f) Each new MDF/IDF/TR shall receive a laminated copy of plans mounted on the wall near the network rack. Arch C (18X24), ANSI C (17X22) or similar sizing,

Coordinate this placement with ICS Layer-1 Cable Plant Engineer *Layer1Engineering@churchofjesuschrist.org*.

(g) Numbering, icons, and drawing conventions used shall be consistent throughout all documentation and in accordance with HQF drafting and labeling standards.

1.4. QUALITY ASSURANCE

1.4.1. Regulatory Agency Sustainability Approvals:

1) The system shall meet the approval of the authority having jurisdiction (AHJ). NEC and State and/or local ordinances and regulations shall govern unless more stringent requirements are specified.
2) Meet all TIA/EIA commercial building wiring standards.
3) All Networks shall be installed per applicable standards and manufacturer's guidelines.
4) Cable assemblies shall be UL / CE Listed and CSA Certified. All jackets shall be UL, VW-1 flame rated.
5) Grounding shall conform to all required Commercial Building Grounding and Bonding Requirements for Telecommunications, Electrical Codes, and Manufacturer's grounding requirements.

1.4.2. Qualification Requirements

1) Manufacturer Qualifications:
   a) Qualified manufacturers are listed in Part 2 – Products. Provide a single source for all products using the systems described. Mixing systems and substitutions are not allowed.
      i) For buildings or complexes with existing non-qualified manufacturer components. Contact ICS Layer-1 Cable Plant Engineer *Layer1Engineering@churchofjesuschrist.org*

2) Company, Contractor and Installer Qualifications:
   a) Provide Company/Contractor certificate showing partnership with the manufacture (PCI certification-Panduit, CSI certification-CommScope, CSV certification-Belden, NPI certification Corning)
   b) Qualified BICSI trained: Provide documentation:
      i) Forman to be installer 2 credential.
      ii) All other Installers to be Installer 1 Credential.
   c) Qualified BICSI comparable trained. Provide documentation:
      i) Category Four Approved Installers.
      ii) Approved and Certified by Manufacturer. Certificate of training completion to be submitted.
   d) Three (3) years of experience with similar projects. Provide documentation.

1.5. Warranty

1.5.1. Cabling System Warranty

1) Provide warranty for permanent link cabling system to meet Category 6/6A standard requirements for a structured cabling system for 20 years.
   a) Provide warranty for fiber backbone system to meet fiber standards, ANSI/TIA/EIA 568-B (568 B.1, B.2, and B.3) requirements for a 20-year warranty minimum.

2. Part 2 – PRODUCTS

2.1. SYSTEMS

2.1.1. No Substitutions.

Any changes must be approved by Church ICS Layer-1 Cable Plant Engineer. For questions, contact the Layer-1 Cable Plant Engineer at *Layer1Engineering@churchofjesuschrist.org*

2.1.2. Manufacturers:

Approved Cable, Connectivity(jacks), and Patch Panel Manufacturers and Products are listed below. Provide a single source for all products using the system described. Mixing systems is not allowed

For buildings or complexes with existing nonstandard cable infrastructure, contact *Layer1Engineering@churchofjesuschrist.org*

1) PAN-GEN system – Use for all new HQF installations (This system WILL NOT be used for this existing facility) - General Cable *www.generalcable.com/eu/en* and Panduit Corporation, Tinley Park, IL. *www.panduit.com*.
   a) General Cable Plenum CAT6E – GenSPEED 6000 Enhanced Category 6 Cable CMP
   b) General Cable CAT6E – GenSPEED 6000 Enhanced Category 6 Cable CMR
   c) General Cable Plenum CAT6A – GenSPEED 10 UTP Category 6A Cable CMP
   d) General Cable CAT6A – GenSPEED 10 UTP Category 6A Cable CMR
   e) General Cable Exterior CAT6A – GenSPEED Category 6A Outside Plant Cable
   f) Panduit Cat6E Jack Module – TX6 PLUS UTP Jack Module, CJ688TG*(Color)
   g) Panduit Cat6A Jack Module – TX6A 10Gig Jack Modules, CJ6X88TG*(Color)
   h) Panduit Cat6A Field Cord – FC-ICCP1MWH (Security camera and WAP station ends only)
   i) Panduit Flat Patch Panel – 1U 48 Port CPP48HDEWBL
   j) Panduit Angled Patch Panel – 1U 48 Port CPPA48HDWBLY (for use with chassis switch configuration)
   k) Panduit Cat6E 28 AWG Patch Cord – TX6-28 PLUS Cat 6 28 AWG UTP Patch Cord UTP28SP1GR (12 inch patch cord for alternating patch panel and switch configuration cabling)
   l) Panduit Cat6E Patch Cord – Pan-Net TX6 PLUS Cat 6 UTP Patch Cord UTPSP*Y (Feet)
   m) Panduit Cat6A Patch Cord – Pan-Net TX6A 10Gig Cat 6A UTP Patch Cord UTP6AX* (Feet) (For use within exiting systems. New configurations use Panduit Cat6E 28 AWG Patch Cords)
   n) Panduit Surface Mounted Box – One module space CBX1**-A and two module space CBX2**-AY

2) Systimax System – ONLY use for existing HQF Systimax installations - Systimax Solutions, a CommScope Company, Hickory, NC. *www.systimax.com*.
   a) GigaSPEED XL 2071E Verified Category 6 U/UTP Plenum Cable, use 1071 when Plenum is not a code requirement or homerun in conduit.
   b) GigaSPEED X10D® 2091B ETL Verified Category 6A /UTP Cable, 760105338 Plenum, 760105759 1091B when Plenum is not a code requirement or homerun in conduit. WAP and Security Camera locations indoor ONLY.
   c) 1592A Category 6A F/UTP Cable, outdoor, black jacket, aluminum tape, Outside Plant (OSP).
   d) GigaSPEED XL MGS400 Category 6 Modular Jack
   e) GigaSPEED X10D® MGS600 Series Information Outlet (760092387 Yellow Security, 760092452 Blue AP locations).
   f) GigaSPEED X10D- 760105429, M4800-1U-GS, 48 port flat patch panel
   g) Patch panel cable support 760104398, One per patch panel.
   h) GigaSPEED GS8E Patch Cords (Black) Station end.
   i) MINO6A U/UTP 28AWG REDUCED DIAMETER LS-CM 4PR Spring Green C0199K2-04F001

j) CCA-CAT6A-PLENUM-WHITE-N018, 760235592 (Indoor WAP, JACE/BMS, and security camera locations).
k) TX6A™ Shielded Field Termination RJ45 Plug FP6X88MTG (Panduit) or RVAFPUBK S1 Modular Connector (Belden) Security camera pole-Mount locations only.
l) Utilize Systimax fiber optic cable. (760127316 | R-012-DZ-8W-FSUYL, Riser rated Indoor), (760053280|D-012-LA-8W-F12NS, Outdoor rated).
m) SD--04U (MDF) 02U/1U (IDF). Utilize an LIU that has 25% room for growth.
n) 760221747 | PNL-CS-12LCW-PT. To be used with SM fiber installation.

3) Fiber Corning Incorporated, Corning, NY. *www.corning.com*
a) Utilize corning fiber optic cable. 012E81-33131-A1 (Riser Indoor rated), 012E8F-31131-A1 (Riser outdoor rated).
b) Housing CCH-04U/03U/02U. Utilize an LIU that has 25% room for growth.
c) Casset CCH-CS12-A9-P00RE (SM). To be used with SM fiber installation.

4) Lightning protection DITEK Corporation, Ditek, FL. *www.diteksurgeprotection.com*
a) Provide one DTK-MRJ-POE device for each outdoor camera/network device. Also, provide 5 as spare for the future. Coordinate installation/design with ICS Layer-1 Cable Engineer, *Layer1Engineering@churchofjesuschrist.org*.

5) Approved Rack/Cabinet Manufacturers and Related Products
a) Floor Mounted Rack:
i) Chatsworth Products (CPI) Cabinets. (2 per MDF)
(1) Adjustable QuadraRack®& ServerRack: 15213-703 set at 33” minimum depth, square hole rails, Black.
ii) Lagrand Ortronics. (2 per MDF)
(1) Mighty Mo 20 Adjustable 4-Post Rack: MM20736ADJ38-B set at 33” minimum depth, square hole rails, Black.
b) Vertical Wire Management:
i) Chatsworth Products (CPI) MCS Master Cabling Section.
(1) 30094-703 Double-Sided MCS (2 per MDF)
(2) 30092-703 Single-Sided MCS (1 per MDF)
ii) Panduit PatchRunner 2.
(1) PR2VD06 (2 per MDF)
(2) PE2VFD06 (1 per MDF)
c) Horizontal Wire Manager: Panduit NetManage HC Horizontal Single Sided Manager
i) NMF1, Black
d) Rack Mount Shelf: Chatsworth Products (CPI)
i) 15255-703 Provide one at the MDF
ii) 40974-719 Provide one per MDF/IDF location
e) Cage Nuts
i) Provide 2 kits per rack/cabinet (all racks and cabinets): 76543-002 M6 x 1.0 250 Zinc

6) Wall Mount Cabinets:
a) Legrand, Middle Atlantic Products, Fairfield, NJ. www.Middleatlantic.com
i) CWR series with a minimum 24 inches of workable depth
b) Hoffman, www.hoffmanonline.com

i) ACCESSPLUS® Double-Hinge Type 1 – Part numbers EWMWG242425 and EWMR24T

7) Rack Mount Power Distribution Unit (PDU):
   a) Contractor to provide quantity 2, Basic 15A (minimum), rackmount Power Distribution Unit suitable to the supplied local power (120/240). Input Shall be C-14, Output Receptacles: Eight (8) to Ten (10) Minimum 1U Horizontal Mounting PDU, Cord Length: 10ft minimum length.

2.1.3. General Criteria

1) Category 6 minimum compliance margin on all parameters beyond category 6 and Power Sum ACR out to 250 MHz
2) Category 6A minimum compliance margin on all parameters beyond category 6A and Power Sum ACR out to 550 MHz
3) Horizontal cables will be rated Category 6 (250 MHz), Category 6A (550 MHz) in performance and rated to comply with ANSI/TIA-568 to connector outlets at Work Area. Horizontal cables will home run back to Telecommunications Room and will terminate on individual Category 6/6A rated jacks to populate modular style patch panel on open racks. All cables will be patched at cutover as interconnection into floor serving active equipment using RJ45 modular equipment cables rated to Category 6/6A as specified.
4) Use the appropriate Riser and Plenum rated cable where applicable. The outdoor-rated cable must be used for outdoor installations.
5) Match additions to the horizontal raceway to complete system according to ANSI/TIA-568 where suspension and protection gaps exist.

2.1.4. Components – Work Area (station end) Subsystem:

1) General:
   a) Provide connectivity equipment used to connect horizontal cabling subsystems and equipment in the work area. Both copper and fiber media shall be supported. Connectivity equipment shall include the following options:
      (1) Patch (equipment) cords and modular connectors.
      (2) Outlets and surface mount boxes.
      (3) Surface raceway and outlet poles.
      (4) Consolidation points / MUTOA.
   b) Copper Connectivity Network Cabling System:
      i) Provide for Work Area subsystem, including all modular connectors.
      ii) Modular connectors shall support high-speed networks and applications designed for implementation on 1Gbps copper cabling.
      iii) Outlets shall utilize fully interchangeable and individual connector modules that mount side-by-side to facilitate quick and easy moves, adds and changes.

2) Modular Connections/Jacks:
   a) The same Manufacturer shall provide modular connectors and patch cords that match horizontal cabling medium and rating.
   b) Data Modules shall be Category 6/6A and match horizontal cabling rating.
   c) Eight position 8P8C modules are required in all work areas and shall exceed the connector requirements of the TIA Category 6 standard.

d) Provide termination cap with strain relief on cable jacket, ensure cable twists are maintained to within 1/8 inch (3 mm) and include the wiring scheme label. Wiring scheme labels shall be available with ANSI/TIA-568-C.0 wiring schemes.
e) Terminations shall use for ANSI/TIA-568-C.0 wiring scheme.
f) Modules shall terminate 4 pair 23 100-ohm solid unshielded twisted pair cable.
g) Modules shall meet ISO 11801 standard including complying with international standard IEC 60603-7 for backward compatibility.
h) Category 6/6A modules shall have UL and CSA approval.
i) Modules shall have ETL verified Category 6/6A performance and ISO 11801 Class E performance in both basic and channel links.
j) Modules shall be universal in design, accepting 2, 3, or 4 pair modular plugs without damage to outer jack contacts.
k) Modules shall be able to be a re-terminated minimum of 10 times and be available in 11 standard colors for color-coding purposes.
l) Work area adapters must be approved by ICS Layer-1 Cable Engineer *Layer1Engineering@churchofjesuschrist.org*.
m) Jack shall snap into all outlets and patch panels.

3) Modular Connections/Jack color code identification.
a) The station location modules/jacks shall match the faceplate, surface mounted box, or systems furniture color at the station end (outlet). The jack at the rack/patch panel shall be Black.

4) Patch Cords:
a) The same Manufacturer shall provide modular connectors and patch cords that match horizontal cabling medium and rating.
b) Patch cords shall be factory terminated with modular plugs featuring a one-piece, tangle-free latch design, and strain-relief boots to support easy moves, adds and changes.
c) Each patch cord shall be 100% performance tested at the factory in channel test to TIA Category 6/6A standard.
d) Constructed with Category 6 23-AWG UTP cable.
e) Constructed with Category 6A 23-AWG UTP cable to match horizontal cabling medium and rating.
f) Patch cords shall come in standard lengths. Patch cord length at the station end is not to exceed 10 feet (3.0 m). Coordinate delivery of patch cords with ICS Layer-1 Cable Plant Engineer *Layer1Engineering@churchofjesuschrist.org*.
g) Patch cords for station locations shall be black.
h) Provide 10% extra station area patch cables.

5) Outlets and Surface Mount Boxes:
a) Outlets and surface mount boxes shall support network systems by providing high-density in-wall, surface mount cabling applications.
b) Wall faceplates shall be flush mount style and match electrical outlet wall faceplate finish.
c) When plastic outlet faceplates are used, they shall be manufactured from high-impact thermoplastic material with a UL 94 flammability rating of 94 HB or better.
d) Residential grade faceplates are NOT acceptable

2.1.5. Components – Telecommunications Room:

1) General:
   a) Connect networking equipment to horizontal and backbone cabling subsystems:
      i) Termination hardware (connectors and patch cords), racks, cable management products, and cable routing products.
      ii) Provide cable termination hardware.
   b) Terminate each horizontal or backbone cabling run using appropriate connectors or connecting blocks depending upon cable type:
      (a) Matching patch cords will be used to perform cross-connect activities or to connect into the networking/voice hardware:
         (i) Category 6 Enhanced Unshielded Twisted Pair (UTP).
         (ii) Category 6A Unshielded Twisted Pair (UTP).
   c) Four-pair Category 6/6A UTP cabling shall be terminated onto four-pair Category 6/6A module:
      (a) All modules shall be terminated using a 568-B wiring scheme.
      (b) Eight position 8P8C modules shall exceed the connector requirements of the TIA Category 6/6A standard.
      (c) Jack termination to 4-pair, 100 ohms solid unshielded twisted pair cable shall be by use of forwarding motion termination cap and shall not require the use of punch down or insertion tool.

2) Rack, Cabinet, and Cabling Management Enclosure:
   a) Cable Management:
      i) Cable Management System shall be used to provide neat and efficient means for routing and protecting fiber and copper cables and patch cords on telecommunication racks and enclosures.
      ii) Provide a complete cable management system comprised of vertical and horizontal cable managers to manage cables on both the front and rear of the rack.
      iii) The system shall protect network investment by maintaining system performance, controlling cable bend radius and providing cable strain relief.
   b) Vertical Cable Management:
      i) Vertical cable managers include 4 and 6-inch-wide (Front/Back) channel trough with a cover that aid in routing, managing and organizing cable to and from equipment. See specific part numbers and layout.
      ii) Panels shall protect network equipment by controlling cable bend radius and providing cable strain relief.
      iii) Provide panels with universal design mounting to 19 inches (480 mm) rack and constructed of steel bases with PVC duct attached.
      iv) Covers shall be able to hinge from either side yet still be easily removed to allow for quick moves, adds and changes.
   c) Horizontal Cable Management:
      i) Horizontal cable managers include components that aid in routing managing and organizing cable to and from equipment where non angled patch panels are required.
      ii) Panels shall protect network equipment by controlling cable bend radius and providing cable strain relief.
      iii) Provide panels with universal design mounting to 19 inches (480 mm) rack and constructed of steel bases with PVC duct attached.
      iv) Duct fingers shall include retaining tabs to retain cables in place during cover removal.

v) Covers shall be able to hinge from either side yet still be easily removed to allow for quick moves, adds and changes.
vi) The contractor shall provide 3, 2RU Horizontal cable managers per rack location at a minimum. Confirm quantity with ICS Layer-1 Cable Plant Engineer *Layer1Engineering@churchofjesuschrist.org*.

6) Modular Connections/Jacks:
   a) The same Manufacturer shall provide modular connectors and patch cords that match horizontal cabling medium and rating.
   b) Data Modules shall be Category 6/6A and match horizontal cabling rating.
   c) Provide termination cap with strain relief on cable jacket, ensure cable twists are maintained to within 1/8 inch (3 mm) and include the wiring scheme label. Wiring scheme labels shall be available with ANSI/TIA-568-C.0 wiring schemes.
   d) Terminations shall use ANSI/TIA-568-C.0 wiring scheme.
   e) Modules shall terminate 4 pair 23 100-ohm solid unshielded twisted pair cable.
   f) Modules shall meet ISO 11801 standard including complying with international standard IEC 60603-7 for backward compatibility.
   g) Category 6/6A modules shall have UL and CSA approval.
   h) Modules shall have ETL verified Category 6/6A performance and ISO 11801 Class E performance in both basic and channel links.
   i) Modules shall be universal in design, accepting 2, 3, or 4 pair modular plugs without damage to outer jack contacts.
   j) Modules shall be able to be a re-terminated minimum of 10 times and be available in 11 standard colors for color-coding purposes.
   k) Jack shall snap into all outlets and patch panels.

3) Modular Connections/Jack color code identification.
   a) Standard Work Area connections – Black at patch panel and match faceplate color at the station location.
   b) Wireless Access Point (WAP) connections – Blue at the patch panel location.
   c) Security equipment/camaras/card reader connections – Yellow at the patch panel location.
   d) JACE/BMS/Lighting control network connections – Purple at the patch panel location.
   e) Emergency/Fire control network connections – Red at the patch panel location.
   f) Analogue, high count pair cable – Orange at the patch panel location.
   g) D-Marc extension with Cat 6e cables from the wall field to the MDF rack, Jacks shall be Green.

4) Patch Cords:
   a) Patch cords for MDF/IDF/TR locations will be contractor supplied. The contractor shall supply one for each horizontal cable. Coordinate lengths with ICS Layer-1 Cable Plant Engineer Layer1Engineering@churchofjesuschrist.org.
   b) Provide patch cords between modular patch panels configured as cross-connect or between the patch panel and networking hardware when a patch is used as interconnect.
   c) Patch cords shall be factory terminated with modular plugs featuring a one-piece, tangle-free latch design, and strain-relief boots to support easy moves adds and changes.
   d) Construct patch cords with Category 6/6A UTP cable.
   e) Patch cords shall be 100% performance tested at the factory in channel test to Category 6/6A standard.

f) Patch cords for MDF/IDF/TR locations shall be Green (353C).

5) Patch Panels:
   a) Four-pair Category 6/6A UTP cabling shall be terminated onto four-pair-punch-down style connecting hardware mounted to the rear of integral patch panels and routed to Category 6/6A modules on the front face of the patch panel.
   b) Patch panels shall be universal for 568-B wiring configurations.
   c) Patch panels shall have removable 1-port design that allows the module to be removed without disrupting other ports.
   d) Integral cable tie mounts shall be included in the panel for cable management on the back of the panel.
   e) Port and panels shall be easy to identify by patch panel number and port number.
   f) Rack-mountable patch panels shall mount to standard 19 inches (480 mm) rack.

6) Ground and Bonding:
   a) Provide Telecommunications Bonding Backbone:
      (1) Ground all telecommunications cable shields, equipment, racks, cabinets, raceways, and other associated hardware that has the potential to act as a current-carrying conductor.
      (2) Install telecommunication Bonding Backbone independent of the building's electrical and building ground.
      (3) Designed per recommendations contained in ANSI/J-STD-607-A Telecommunications Bonding and Grounding Standard.
   b) All wires used for telecommunications grounding purposes shall be identified with green insulation:
      (4) Non-insulated wires shall be identified at each termination point with a wrap of green tape.
      (5) All cables and bus bars shall be identified and labeled as required.

7) Firestopping:
   a) Furnish and install fire stopping as per Section 07 8400.

3. Part 3 – EXECUTION

3.1. INSTALLATION

3.1.1. General:

1) A horizontal distribution cabling system is the portion of the telecommunications cabling system that extends from work area telecommunications outlet/connector to horizontal cross-connect in the Technology Room.
   a) Horizontal cabling in an office should terminate in the Telecommunications Room located on the same floor as Work Area being served.
   b) Horizontal cabling is installed in a star topology (home run).
   c) Bridged taps and splices are not permitted as part of copper horizontal cabling.
   d) Above ceiling cable pathways must be accessible every 15' through removable lay-in ceiling panels or 24"x24" minimum access panels in hard ceilings.
2) Install a communications system per Manufacturer's written instructions and complying with applicable portions of NEC 'Standard of Installation.'

3) Install a structured cabling system that will be able to support interconnections to active telecommunications equipment for voice and data applications in a multi-vendor, multi-product environment. The structured cabling system should adhere to ANSI/TIA-568-C.0, ANSI/TIA-568-C.1, ANSI/TIA-568-C.2, ANSI/TIA-606-A; ANSI/J-STD-607-A, and ANSI/TIA-942-2 for pathways, distribution, administration, and grounding standards of the system.
4) Security camaras and WAP equipment must use CAT 6A rated cable, jacks, plugs, and patch cords. Use plenum rated cable in all above ceiling applications. Use outside plant CAT 6A cable for all exterior cameras not mounted on the building facade.

3.1.2. Work Area Outlets:

1) Install, terminate, test, and guarantee each drop according to customer standards and preferences.
2) Cables shall be coiled in in-wall or surface-mount boxes if adequate space is present to house cable coil without exceeding the Manufacturers bend radius.
   a) No more than 12 inches (300 mm) of UTP slack shall be stored in the in-wall box, modular furniture raceway, or insulated walls.
   b) Extra cable shall be loosely configured and stored in the ceiling above each drop location or in floor trough system.
   c) Provide 10’ of neatly coiled extra cable service loop above celling at each WAP location.
   d) Provide 5’ of neatly coiled extra cable service loop close to each security camera.
   e) Provide 5’ of neatly coiled extra cable service loop above celling, in floor trough, or cable tray close to each work desk location.
3) Cables shall be dressed and terminated per ANSI/TIA-568-C.0, Manufacturer's recommendations, and best industry practices.
4) Pair untwist at termination shall not exceed 0.125 inches (3.175 mm).
5) Bend radius of cable in the termination area shall not be less than 4 times outside the diameter of the cable.
6) Cable jacket shall be maintained to within one inch (25 mm) of the pin termination point.
7) When using surface mounted boxes provide a minimum of 12 inches of cabling from wall, floor, or systems furniture penetration to box.
8) All exposed horizontal cabling in the work area must be wrapped with black spiral cable wrap. Patch cables are not wrapped.
9) When a fixed faceplate is not within 15’ of the workstation or equipment, end cable from patch panel within 5’ of the workstation or equipment and terminate with a single or double port Surface Mounted Box (biscuit).
10) Cable runs from switch or patch panel to Work Area termination or station end shall not exceed 90m or 295ft.

3.1.3. Horizontal Cross Connect:

1) Cables shall be dressed and terminated per ANSI/TIA-568-C.0, Manufacturer's recommendations, and best industry practices.
2) Pair untwist at termination shall not exceed 0.125 inches (3.175 mm).
   a) Bend radius of cable in the termination area shall not be less than 4 times outside the diameter of the cable.
3) Cables shall be neatly bundled and dressed to their respective panels or blocks.
   a) Each panel or block shall be fed by individual bundle separated and dressed back to point of cable entrance into rack or frame.
4) The cable jacket shall be maintained as close as possible to the termination point.

5) Each cable shall be clearly labeled on cable jacket behind patch panel at a location that can be viewed without removing bundle support ties.
   a) Cables labeled within a bundle, where the label is obscured from view shall not be acceptable.
6) Horizontal Cabling:
   a) Cable raceways shall not be filled greater than required by ANSI/TIA-569-B maximum fill for specific raceway type.
   b) Cable raceway shall have a radius drop installed where cable exit or enter the raceway. To protect the cable in the transition from horizontal to vertical runs. This is not only applicable to MDF/IDF closet locations. This applies to all data/communication raceway.
   c) Cables shall be installed in continuous lengths from origin to destination (no splices) except for transition points, or consolidation points.
   d) Where transition points or consolidation points are allowed, they shall be in accessible locations and housed in enclosure intended and suitable for the purpose.
   e) Cable's minimum bend radius and maximum pulling tension shall not be exceeded.
   f) J-hooks can be used to support cable bundles of 10 or less outside TRs
   g) If J-hooks are used to support cable bundles, all horizontal cables shall be supported at 48 inches (1200 mm) to 60 inches (1500 mm) maximum intervals. At no point shall cable(s) rest on acoustic ceiling grids or panels.
   h) Horizontal distribution cables shall be bundled in groups of no more than 25 cables. Cable bundle quantities in excess of 25 cables may cause deformation of bottom cables within a bundle and degrade cable performance.
   i) Velcro wraps shall be used for all cable bundles where needed. Cable Ties SHALL NOT be used anywhere in the horizontal infrastructure.
   j) Cable shall be installed above fire-sprinkler systems and shall not be attached to the system or any ancillary equipment or hardware. Cable system and support hardware shall be installed so that it does not obscure any valves, fire alarm conduit, boxes, sprinkler heads, or other control devices.
   k) Cables shall not be attached to ceiling grid or lighting fixture wires. Where support for horizontal cable is required, install appropriate carriers to support cabling.
   l) Cables shall be identified by self-adhesive labels and meet the requirements of ANSI/TIA-606-A-1.
   m) Unshielded twisted pair cable shall be installed so that there are no bends smaller than four times the cable outside diameter at any point in run and at the termination field.
   n) Pulling tension on 4-pair UTP cables shall not exceed 25 lbf (111 N) for a four-pair UTP cable.

3.1.4. Vertical Outlet Pole and Surface Raceway:

1) Vertical outlet poles and Surface Raceway refers to the surface raceway system used for branch circuit wiring and/or data network, voice, video and other low-voltage cabling. A surface raceway shall be used in solid wall applications or for applications where moves, additions, and changes are very typical to the workflow.
2) A raceway system shall consist of raceway, appropriate fittings and accessories to complete the installation per electrical Contract Documents. A non-metallic surface raceway is to be utilized in dry interior locations only as covered in Article 352, part B of the NEC, as adopted by the NFPA and as approved by the ANSI.

3.1.5. Copper Termination Hardware:

1) Cables shall be dressed and terminated per ANSI/TIA-568-C.0, Manufacturer's recommendations, and best industry practices.
2) Pair untwist at termination shall not exceed 0.125 inches (3.175 mm).
3) Bend radius of cable in the termination area shall not be less than 4 times outside the diameter of the cable.
4) Cables shall be neatly bundled and dressed to their respective panels or blocks.
5) Each panel or block shall be fed by individual bundle separated and dressed back to point of cable entrance into rack or frame.
6) The cable jacket shall be maintained as close as possible to the termination point.
7) Each cable shall be clearly labeled on cable jacket behind patch panel at a location that can be viewed without removing bundle support ties.
    a) Cables labeled within a bundle, where the label is obscured from view shall not be acceptable.

3.1.6. Grounding System:

1) Telecommunications main grounding bus bar (TMGB) and Bonding Backbone shall be designed and/or approved by qualified Installers with three separate and distinct systems for the site.
2) AC grounding electrode (GEC) ground electrode conductor connects equipment to the grounding electrode.
3) Equipment grounding system maintains 0V on all equipment enclosures and power supplies and acts as an intentional path for a fault condition.
4) Telecommunications bonding infrastructure follows the requirements of ANSI/J-STD-607-A.
5) All service providers must be consulted to determine any special grounding requirements.

3.1.7. Identification and Labeling:

1) Apply machine-generated approved labeling for racks, cables, panels, and outlets that follows approved submittal (see Submittals 1.3.2.2):
    a) Designate cables origin and destination and a unique identifier for cable by telecommunication room(TR), rack, patch panel number, and patch panel port number.
    b) Racks and patch panels shall be labeled to identify numeric sequence within the TR space that shares the cable system infrastructure.
    c) All work area faceplates shall be labeled according to the approved submittal
    d) Outlet, patch panel and wiring block labels shall be installed on, or in, space provided on a device as designed.
    e) Cabling shall be labeled 4-12” inches from the end of the cable at both ends. With a wraparound style label, that is machine printed. Handwritten labels are not acceptable.

3.1.8. Fiber Optic Cable:

1) Minimum 12-strand
2) All additions in divisible increments of 12 (12, 24, 48, etc.)
3) Innerduct required for all fiber backbone cable.
4) All fiber will be factory polished LC terminations requiring pigtail fusion slice. See Section 2.1.2.3.o and 2.1.2.4.a.
5) Fiber type shall be Single Mode, SM Armored. See specific manufacturer part numbers. 2.1.2
6) Riser rated armored between building floors.
7) Outdoor armored rated for building to building backbone.
8) OTDR testing required with no more than 6dB loss across the building distributor or campus distributor endpoints.

9) Fluke approved test equipment-DSX2-8000, or DSX2-5000. or Viavi Solutions' Certifier10G or Certifier40G with firmware version 8.1 or newer with appropriate fiber modules.
10) All building fiber and pathways shall be engineered and installed as a home-run backbone to each TR from the Entrance Facility (EF), Main Equipment Room (ER) or Campus Distributor (CD) endpoint.
11) Fiber jumpers must match the manufacturer of backbone fiber.
12) The contractor shall provide quantity 8, 2-meter SM, LC/LC duplex fiber jumpers for the MDF. For every additional IDF location, the quantity should increase by 4 fiber jumpers. Coordinate with ICS Layer-1 Cable Plant Engineer *Layer1Engineering@churchofjesuschrist.org* prior to installation.

3.1.9. Copper Backbone:

1) Minimum 12-pair Cat 3, Cat 5e or Cat 6e
2) Lighting protection and grounding termination required per requirements and building code.
3) All additions in increments of 12 (25, 50, 100, etc.)
4) No splicing permitted
5) Riser rated between building floors
6) Outdoor rated between buildings
7) Pathways shall be engineered and installed as a home-run backbone to each TR from the Entrance Facility (EF), Main Equipment Room (ER) or Campus Distributor (CD) endpoint.
8) The contractor shall install a minimum 12 pair cable, that will be extended from a 110-wall field/fuse protection location in the MDF to the MDF/IDF rack location. Terminated on a modular 24 port patch panel, one pair per port. Jacks shall be Orange in the patch panel. Consult with ICS Layer-1 Cable Plant Engineer *Layer1Engineering@churchofjesuschrist.org* prior to installation.
9) When a cable is run in building, fuse protection is not necessary. Terminate the copper directly to the patch panel. One pair per port and 12 pair minimum on Orange jacks.

3.1.10. D-marc extension for the network:

1) At the MDF wall field location. The contractor shall install quantity six (6), Cat 6e network cables in a surface mount box secured to the wall near the D-marc (Demarcation point), Service provider handoff and routed/terminate to a patch panel in the network rack. Jacks shall be Green. Consult with ICS Layer-1 Cable Plant Engineer *Layer1Engineering@churchofjesuschrist.org* prior to installation.

3.2. FIELD QUALITY CONTROL

3.2.1. Field Tests:

1) General:
   a) Provide testing upon completion of installation.
   b) Testing to be per ANSI/TIA standards and Manufacturer's system warranty guidelines and best industry practice.
   c) If any of these are in conflict, discrepancies shall be brought to the attention of the Architect/Consulting Engineer for clarification and resolution.
   d) Cables and termination hardware:
      i) Test a complete system for defects in installation.
      ii) Verify cabling system performance under installed conditions according to requirements of ANSI/TIA-568-C.
      iii) All pairs of each installed cable shall be verified prior to system acceptance.

iv) Any defect in cabling system installation including but not limited to cable, connectors, feed-through couplers, patch panels, and connector blocks shall be repaired or replaced in order to ensure 100% useable conductors in all cables installed.

2) Copper channel testing:
   a) All twisted-pair copper cable links shall be tested for compliance to requirements of ANSI/TIA-568-C for each Category 6/6A cable installed. The testing shall be performed by a certified testing unit approved by the manufacturer for all warranties and certifications.
   b) Backbone multimode fiber cabling shall be tested at both 850 nm and 1300 nm. Single Mode fiber shall be tested at both 1310 & 1550 nm.

3) UTP Cables and Links testing:
   a) UTP cabling channel must be tested at swept frequencies up to 250 MHz for internal channel performance parameters as defined in IEEE 802.3 and ANSI/TIA 568-C.0-2. Certifications shall include the following parameters for each pair of each cable installed:
      i) Wire map (pin to pin connectivity).
      ii) Length (in feet or millimeters).
      iii) Near-End Crosstalk (NEXT).
      iv) Far-End Crosstalk (FEXT).
      v) ELFEXT.
      vi) Attenuation/Crosstalk Ration (ACR).
      vii) Return Loss.
      viii) Propagation Delay.
      ix) Delay Skew.
      x) The test equipment shall provide an electronic and printed record of each cable tested.

   b) Test each pair of cable for opens, shorts, grounds, and pair reversal.
      i) Correct short or grounded and reversed pairs.
      ii) Examine open and shorted pairs to determine if a problem is caused by improper termination.
      iii) If termination is proper, tag bad pairs at both ends and note on termination sheets.
      iv) If horizontal cable contains bad conductors, remove and replace the cable.

4) Testing Equipment:
   a) Comply with the requirements of ANSI/TIA-568-C.
      i) Appropriate level III tester shall be used to verify Category 6 cabling systems.
   b) UTP Cables and Links test equipment:
      i) Category Four Approved Testing Equipment. See Section 01 6200 for definitions of Categories:
      ii) Fluke approved test equipment-DSX2-8000, or DSX2-5000.
      iii) Viavi Solutions' Certifier10G or Certifier40G with firmware version 8.1 or newer
5) Onsite Owner-contractor testing:
   a) The contractor shall meet with ICS Cable Engineer onsite and field test at random up to 30-50% of the completed system. This is for both copper and fiber. Locations to be selected by ICS engineer.
6) Re-Testing:
   a) Consulting Engineer may request a 10% random field re-test to be conducted on a cable system, at no additional cost to Owner, to verify documented findings.

i) Tests shall be repeated of those defined above.
ii) If findings contradict documentation submitted, additional testing can be requested to the extent determined necessary by Consulting Engineer, including a 100% re-test at no additional cost to the Owner.

7) Tests and Evaluation Reports:
   a) Printouts generated for each cable by wire test instrument shall be submitted as part of the documentation package. The installer may furnish this information in electronic form.
   b) The media shall contain the electronic equivalent of test results as defined by the Section along with software necessary to view and evaluate test reports.
   c) Submit documentation within ten (10) working days of completion of each testing phase. This is inclusive of all test results and record drawings.
   d) Draft drawings may include annotations done by hand. Final copies of all drawings shall be submitted within thirty (30) working days of completion of each testing phase.
   e) Proved copies of original test results in hard copy and soft copy formats.
8) Test Documentation:
   a) Provide electronic format documentation within three (3) weeks after completion of the project.
   b) Documentation shall be clearly marked on the outside front cover with following:
      (1) "Project Test Documentation".
      (2) Project name.
      (3) Date of completion (month and year).
   c) Test results shall include the following:
      (1) Record of test frequencies.
      (2) Pass/Fail status (* Star Passes are NOT acceptable).
      (3) Cable type.
      (4) Conductor pair and cable (or outlet) I.D.
      (5) Measurement direction.
      (6) Reference setup.
      (7) Crew member names(s).
      (8) Test equipment name, manufacturer, model number, serial number, software version.
      (9) Last calibration date: Unless Manufacturer specifies a more frequent calibration cycle, annual calibration cycle is required on all test equipment used on the project.
      (10) The document shall detail the test method used and specific settings of equipment during the test as well as the software version being used in field test equipment.

3.2.2. Non-Conforming Work

Non-conforming work as covered in the General Conditions applies, but is not limited to the following:

1) Any cable damaged or exceeding recommended installation parameters during installation shall be replaced at no additional cost to the Owner.
2) Any defect in cabling system installation including, but not limited to, cable, connectors, feed-through couplers, patch panels, and connector blocks shall be repaired or replaced in order to ensure 100% useable conductors in all cables installed at no additional cost to the Owner.
3) Correct deviation and repeat applicable testing at no additional cost to the Owner.
4) Correct any work found defective or not complying with Association Publications and TDMM requirements at no additional cost to the Owner.
5) Document all problems found and corrective action taken. Include both failed and passed test data.

END OF SECTION 27 1500

SECTION 281602 INTRUSION DETECTION SYSTEM

PART 1 – GENERAL

1.1 SUMMARY

A. Includes But Not Limited To:

1. Furnish and install intrusion detection system as described in Contract Documents.

2. Furnish and install raceway, cable and conductors, boxes, and miscellaneous items necessary for complete system.

B. Related Sections:

1. Section 01 12 00: Multiple Contract Summary.

2. Division 26:

a. Quality of and installation standards for wiring, raceway, conduit and boxes.

b. Power provisions

c. Telephone lines and Ethernet cable.

3. Section 28 13 01: Access Control System.

4. Section 28 23 01: Video Surveillance System.

1.2 SYSTEM DESCRIPTION

A. The system areas and zones shall be programmable, and the system shall store, log, display, and transmit specific custom designations for system areas, zones, and user names.

B. The system shall support user interaction by way of a keypad, web browser, system software, key switch, or radio frequency wireless control, Text messaging, or Smart Phone Application using integrated or auxiliary devices provided by the system manufacturer.

C. The system shall support controller zone input connections, system keypads, system zone expansion modules, and wireless zone input modules, and must support zone input connections by way of at least two competitive products. The system shall offer a seamless integrated compatibility with hard-wire and/ or wireless zone expansion equipment for at least 500 wireless zones and/ or a maximum of 574 hardwired zones.

D. The system shall be capable of offering up to five zone expansion buses, each of which can support the connection of up to 15,000 feet of four-wire cable. Zone expansion and keypad data buses that exceed 2,500 feet of cable must include splitter/repeater modules to boost data voltage and maintain data integrity.

E. The system shall provide a seamless capability to provide up to 506 addressable relays, which can be located at any connection location upon a zone expansion bus.

F. System relay outputs shall have the capability of being triggered as a result of a command from the user interface, changes in system status, changes in zone status, or by a programmable schedule.

G. System relay output states shall be programmable for momentary, maintained, pulsed, or must follow the state of an associated system zone input.

H. The system shall be completely programmable either locally from a keypad or remotely through a standard dial-up, and network connections by way of a LAN, WAN, and/or by way of the Internet, cellular communications paths.

I. The control unit shall be completely programmable remotely using remote annunciators, and/ or using upload/ download software that communicates using SDLC 300 baud, 2400 baud, or IP Addressed data network. On-site programming from a personal computer shall also be permitted.

J. The control unit shall be equipped with an anti-reversing circuit breaker to prevent damage due to accidental reversal of battery leads.

1.3 GENERAL COMPONENT REQUIREMENTS

A. Component Enclosure

1. Housings; power supply enclosures, terminal cabinets, control units, and other component housings, collectively referred to as enclosures shall be so formed and assembled as to be sturdy and rigid. If sheet steel is used in the fabrication of enclosures, it shall be not less than an 18 gauge door with a 20 gauge box frame. Where exposed pins, the hinges shall be of the tight pin type or the ends of hinge pins shall be tack welded to prevent ready removal. Doors having a latch edge length of less than 24 inches shall be provided with a single lock. Where the hinged door latch edge is 24 inches or more in length, doors shall be provided with three-point latching device with lock; or alternatively with two locks, one located near each end. For SCIF and High Security applications an attack proof enclosure with proper tampers listed for use with the XR150/XR350/XR550 with Network and Encryption shall be used.

B. Electronic Components

1. All system electronic components shall be solid-state type, mounted on printed circuit boards. Light duty relays and similar switching devices shall be solid-state type or electromechanical.

2. The panel shall have an over current notification LED that lights when devices connected to the Keypad Bus and Loop Expansion LX-Bus(es) draw more current than the panel is rated for. When the over current LED lights, the Loop Expansion LX-Bus (es) and Keypad bus are shut down.

C. Control Unit

1. A battery test shall be automatically performed to test the integrity of the standby battery. The test shall disconnect the standby battery from the charging circuit and place a load on the battery. This test shall be performed no more than every 180 seconds.

2. The control unit shall be capable of operating and supervising notification appliance devices as well as addressable initiating detection devices and an integrated supervised dual line digital communicator.

3. Control unit must be "Flash ROM" updatable, and program must be held in non-volatile RAM. The panel shall be able to function while the update is in process.

4. Control unit shall be capable of operating using an optional built in Encrypted Alarm Router for SCIF (Sensitive Compartmented Information Facility) applications that is certified by NIST (National Institute of Standards and Technology) for 128 or 256 Bit AES (Advanced Encryption Standard) Encryption communications.

5. The optional built-in Encrypted Alarm Router shall be capable of compliance with ICD /ICS 705 Chapter 7 Intrusion Detection Systems (IDS) and UL 2050 standards.

D. Remote Annunciators

1. The system shall support a maximum of sixteen (16) supervised remote annunciators with the identical capabilities, functions and display layout. Operation of the remote annunciators shall be limited to authorized users by the use of a code or key.

2. The remote annunciators shall be capable of operating at a maximum wiring distance of 15,000 feet from the control unit on unshielded, non-twisted cable.

E. Control Designations

1. Controls shall be provided to ensure ease of operation of all specified characteristics. Where applicable, clockwise rotation of controls shall result in an increasing function. Controls, switches, visual signals and indicating devices, input and output connectors, terminals and test points shall be clearly marked or labeled on the hardware to permit quick identification of intended use and location.

F. Test Modes

1. The system shall include a provision that permits testing from any alphanumeric keypad. The test shall include standby battery, alarm bell or siren, and communication to the central station.

2. The system shall include a provision for an automatic, daily, weekly, thirty (30) day, or up to sixty (60) day communication link test from the control panel installation site to the central station.

3. The system shall include a provision for displaying the internal system power and wiring conditions. Internal monitors shall include the bell circuit, AC power,

battery voltage level, charging voltage, panel box tamper, phone trouble line 1, phone trouble line 2, transmit trouble, and network trouble.

G. Power Supplies

1. Power supplies for the control unit shall operate from 120 VAC, supplied at the respective protected areas. Standby batteries shall be supplied to power the system in the event of a utility power failure. Batteries shall be sized to provide 105% capacity for eight hours. Standby batteries shall be sealed lead-acid. Power supplies shall be all Solid State.

2. Controls shall be designed to maintain full battery charge when alternating current is available. Batteries shall be recharged to 85% capacity within 24 hours from battery use. The system shall be automatically transferred to battery power upon loss of alternating current power and return to alternating current power upon restoration. Intrusion alarms shall not be initiated during switch over; a signal shall be initiated upon failure of battery or alternating current power.

3. Approved power supplies shall meet or exceed the following power supply model specifications:

   a. UL Listed DMP 505-12: 12VDC 5 amp with transformer and enclosure.

H. Software

1. The system shall interface with computer software with the capability to fully program the panel by connecting to the panel through:

   a. Direct cable connection interface card

   b. Receiver phone line connection

   c. Standard phone line connection

   d. Ethernet network connection

   e. Network connection across the Internet

2. The system shall interface with computer software capable of locking down all controlled doors.

3. The system shall interface with computer software capable of monitoring and logging all events.

4. The system shall interface with computer software capable of exporting reports in the following file formats:

Excel spreadsheet (*.xls)	Text (*.txt)
Rich Text (*.rtf)	Comma-separated (*.csv)
Windows Metafile (*.wmf)	HTML document (*.htm)
QuickReport (*.qrp)	

5. The system shall interface with computer software capable of printing custom, filtered reports including:

All Events	Door Access Granted
Zone Action	Door Access Denied
Arming/Disarming	Opening/Closing Schedule Changes
Area Late to Close	System Monitors
User Code Changes	System Events

1.4 FUNCTIONAL DESCRIPTIONS

A. User/Authorization Level Capacity

The system shall be capable of operation by 10,000 unique Personal Identification Number (PIN) codes with each code having one (1) of ninety-nine (99) custom user profiles. This allows for limitation of certain functions to authorized users. The operation of all keypads shall be limited to authorized users.

B. Keypads

1. The system shall support a maximum of sixteen (16) keypads with alphanumeric display. Each keypad shall be capable of arming and disarming any system area based on a pass code or Proximity key authorization. The keypad alphanumeric display shall provide complete prompt messages during all stages of operation and system programming and display all relevant operating and test data.

2. Communication between the control panel and all keypads and zone expanders shall be multiplexed over a non-shielded multi-conductor cable, as recommended by the manufacturer. This cable shall also provide the power to all keypads, zone expanders, output expanders, and other power consuming detection devices.

3. If at any time a keypad does not detect polling, the alphanumeric display shall indicate "SYSTEM TROUBLE". If at any time two devices are programmed for the same address, the alphanumeric keypad shall display “4 WIRE BUS TROUBLE”. If at any time a keypad detects polling but not for its particular address, the alphanumeric display shall indicate "NON POLLED ADDR". The system shall display all system troubles at selected keypads with distinct alphanumeric messages.

4. The keypad shall include self-test diagnostics enabling the installer to test all keypad functions: display test, key test, zone test, LED test, relay test, tone test, and address test.

5. The keypad shall provide an easy-to-read English text display. The text shall exactly match the text seen in all software reports, keypad displays, and central station reports.

6. The keypad user interface shall be a simple-to-use, menu-driven help system that is completely user friendly.

7. The control panel shall support a keypad interface accessible on the World Wide Web in a browser window. The web-accessible keypad interface shall provide at least five (5) programmable hyperlinks for camera access or other use.

C. Zone Configuration

1. A minimum of 4 Class B ungrounded zones shall be available at each keypad or zone expander on the system. The system shall have the capacity for a maximum of sixteen (16) keypads and a maximum of 125 four (4) zone expanders or 500 single zone expanders. It shall also have the capacity of a maximum of 125 supervised relay output expanders. All Class B zones shall be 2-wire, 22 AWG minimum, supervised by an end-of-line (EOL) device and shall be able to detect open and short conditions in excess of 500ms duration.

2. Each zone shall function in any of the following configurations: Night, Day, Exit, Fire, Supervisory, Emergency, Panic, Auxiliary 1, Auxiliary 2, Fire Verification, Cross Zone, Priority, and Key Switch Arming.

3. The digital SLCs and the annunciator/keypad bus shall be able to operate at a maximum wiring distance of 2500 feet from the control panel on unshielded, non-twisted cable. This distance may be extended to a total of 15,000 feet when bus repeater modules are installed.

4. Each zone shall function in any of the following configurations:

- Night
- Day
- Exit
- Fire
- Supervisory
- Emergency
- Arming
- Panic
- Auxiliary 1
- Auxiliary 2
- Fire Verification
- Cross-Zone
- Priority

D. Communication

1. The system shall be capable of signaling to as many as 8 remote monitoring station receivers. Seven (7) of the eight (8) paths shall be capable of being assigned as either a “primary” or “backup” path. In such a manor the system shall have multiple primary paths to multiple remote monitoring stations as well as multiple backup paths to multiple monitoring stations.

2. The system shall employ Adaptive Technology that allows a Backup communication path programmed for Network or Cellular to automatically ADAPT to the faster check-in rate of the Primary path should the Primary path become unavailable. This creates a seamless transition for communication.

3. The system shall be capable of dialing up to (2) remote monitoring station receivers, four telephone numbers of 32 digits each using two separate switched telephone network lines such that if two unsuccessful attempts are made on the first line to the first number, the system shall make two attempts on first line to the second number. If these two attempts are unsuccessful, the system shall make two further attempts on the first line of the first number. After the tenth unsuccessful attempt, dialing shall stop and the alphanumeric keypad shall display trouble. Should another event occur that requires a report to be transmitted, the dialing sequence shall be repeated. The system shall have a programmable option to dial a second set of telephone numbers after the first ten attempts using the same sequence.

4. The system shall be capable of communication using the IBM Synchronous Data Link Control format, and at least one other standard industry format.

5. The system shall be capable of supporting Network communication with digital dialer backup, existing Ethernet data networks, satellite communication, fiber optic networks, local area networks, wide area networks, cellular communication, and retail data networks.

6. The system shall communicate to the Church GSOC Operations Center via contact ID or SSIA protocols to allow for monitoring of all points.

E. Network Communication

1. The control panel shall be capable of asynchronous network communication with a retry time between 2 and 240 minutes and a fail time of 2 and 240 minutes. If communication is unsuccessful the control panel shall be capable of attempting backup communication through any of the available communication methods to the same receiver or a backup receiver.

2. The control panel shall employee adaptive communication technology. Adaptive Technology allows a Backup communication path programmed to use Network or Cellular to automatically ADAPT to the faster check-in rate of the Primary path should the Primary path become unavailable, creating a seamless transition for communication of messages. Select Adapt when programming the Check-in option. This allows a system to be fully supervised even if a path fails, while also keeping wireless charges low when the network is good.

3. Network communication between the control panel and the receiver shall be in a proprietary communication format.

4. The control panel shall be capable of supporting Dynamic Host Communication Protocol (DHCP) Internet Protocol (IP) addressing.

5. Underwriters Laboratories (UL) shall list network communication by the control panel for Standard or Encrypted Line Security.

6. The control panel shall be capable of two-way network communication using standard Ethernet 10/100 BaseT in a LAN, WAN, or Internet configuration.

7. The control panel shall be capable of communication by means of a 128 or 256 Bit AES (Advanced Encryption Standard) Encryption process certified by NIST

(National Institute of Standards and Technology) to an SCS-1R receiver with a built-in Encryption Alarm Router.

8. The control panel shall be capable of meeting ICD/ICS 705 Chapter 7 Intrusion Detection Systems (IDS) and UL 2050 standards.

9. The control panel shall be capable of sending Text messaging to up to three Cellular Phone Numbers using cellular communications.

10. The control panel shall be capable of sending the following Text messages:

- Zone Alarms by Zone Name
- Zone Troubles by Zone Name
- Zone Bypass by User
- Arming (Closings) by User
- Disarming (Openings) by User
- Abort, Cancel and Alarm Verified by User
- AC Power Trouble and Restoral
- System Low Battery
- Ambush
- Check-in by user
- Late to Close

F. TCP/IP Network Trapping

1. The control panel shall be capable of having communication set to Network operation. When a trap is set in Remote Link, the software shall be capable of sending a panel trap message with the panel account number to the SCS-104 installed in an SCS-1R receiver.

2. The receiver SCS-104 shall store the trap and monitor the panel for the next message. When the panel sends its next message, the receiver SCS-104 shall then send a message to the panel to contact Remote Link at the IP address contained in the original trap message.

3. The trap message shall be stored in the receiver SCS-104 for up to four hours. If the trap message is not sent to the panel within the four-hour window, the panel trap message shall be discarded and a new trap message must be sent from Remote Link.

4. The user shall be able to view the trap status in the receiver SCS-104 in Remote Link using the Trap Query function.

G. NAC Circuit Configuration

1. The system shall be capable of additional Style W NAC circuits utilizing the Model 867 Notification Module. Each module shall be controlled and supervised via the SLC loop and monitor for short circuits, open circuits, and ground faults. The NAC circuits shall monitor for external NAC trouble conditions.

2. The system shall be capable of providing Style W/X NAC circuits utilizing the Model 865 Notification Module. Each module shall monitor for short circuits, open circuits, and ground faults. The NAC circuits shall monitor for external NAC trouble conditions and have a manual bell silence switch.

1.5 SYSTEM PERFORMANCE

A. Intrusion detection system shall interface with Video Surveillance System through input modules.

1. Input from Video Surveillance System shall activate alarm during after-hours operation.

B. Intrusion Detection System interface to Zetron Voice system shall be through relay modules. See security schedules for actions when system is in armed and disarmed mode.

1. During armed mode, security points shall provide an active output.

2. Panic switches shall alarm in disarm mode.

3. Glass break devices shall alarm in disarm mode.

C. Intrusion detection system interface with dial-out system through relay modules dial out through a contract ID protocol DMP panel.

1. The security panel shall monitor all points and communicate over Zetron or when armed to the DMP panel to communicate with GSOC. The graphical interface shall indicate each alarm point's alarm status and whether each point is armed or disarmed. System shall automatically arm at a night set time.

D. Every secured point shall activate audible alarm at every keypad.

E. Keypads shall have capability to arm / disarm security points, except glass break and panic devices.

1.6 SUBMITTALS

A. Shop Drawings:

Shop drawings shall consist of a complete list of equipment and materials, including manufacturer's descriptive and technical literature, performance charts and curves, catalog cuts, and installation instructions.

B. As-Built Drawings

1. The contractor shall provide a complete set of as-built drawings for the entire system upon installation completion. These drawings shall include, but not be limited to, the exact locations of all equipment, connections between all equipment, and wiring for all equipment as the system is installed. Typical riser diagrams are not acceptable.

C. Spare Parts Data

1. After shop drawings are approved, a list of spare parts data for each item of specified materials and equipment shall be submitted. The data shall include a complete list of parts and supplies with current unit prices and source of supply. Spare parts shall consist of, but not be limited to, five (5) percent of all initiating and notification appliances with a minimum of one (1) each. All spare parts shall be on site prior to commencement of acceptance testing. Depleted spare parts shall be replaced prior to beneficial occupancy.

D. Operating Documents

1. The contractor shall furnish to the architect operating instructions outlining the step-by-step procedures required for system start-up, operation, and shutdown at least thirty (30) calendar days prior to acceptance test. The instructions shall include the manufacturer's name, system model number, service manual, parts list, and a description of all equipment and their basic operating features.

E. Maintenance Documents

1. The contractor shall furnish maintenance instructions listing routine maintenance procedures, possible breakdowns and repairs, and troubleshooting guides at least 30 calendar days prior to acceptance test.

F. Performance Test Reports

1. Upon the installed system completion and testing, test reports shall be submitted in booklet form showing all field tests performed to prove compliance with specified performance criteria.

G. Warranty

1. A copy of the manufacturer's warranty for all equipment and materials shall be provided. Warranty shall be for all equipment, materials, installation, and workmanship for a minimum of three (3) years, unless otherwise specified.

H. Closeout:

1. Operations and Maintenance Manual Data:

a. Modify and add to requirements of Section 01 78 00 as follows:

1) Provide operating and maintenance instructions by factory trained representative for each item of equipment installed. Provide instruction manual from Manufacturer that explains what is to be done in the event of various indications.

2) Include copy of approved shop drawings and set-up and programming on CD.

1.7 QUALITY ASSURANCE

A. Regulatory Requirements:

1. System Manufacturer shall be certified as being ISO9001 compliant.

2. NEC and local ordinances and regulations shall govern unless more stringent requirements are specified.

3. Equipment, devices, and cable shall be UL listed.

1.8 STANDARDS

A. The system shall be listed as a Power Limited Device and be listed under the standards in the table. Each system shall be supplied with complete details on all installation criteria necessary to meet all of the listings.

Burglary Listings

UL 1023 Household Burglar Alarm System Units

UL 1076 Proprietary Burglar

UL 1610 Central Station Burglar Alarm Units

UL 1635 Digital Burglar Alarm Communicator System Units

Fire Listings

UL 985 Household Fire Warning

Access Control Listings

UL 294 Access Control System Units

Related Listings

NFPA 70 National Electric Code (NEC)

NFPA 72 Local Protective Signaling

NFPA 72 Remote Station Protective Signaling

NFPA 72 Proprietary Protective Signaling

NFPA 72 Household Fire Warning

U.S. Government Standards/Listings

Meets ICD /ICS 705 Chapter 7 Intrusion Detection Systems (IDS)

Meets DoD/NIST SCIF Standards

1.9 AMERICANS WITH DISABILITIES

A. All indicating and notification appliances shall comply with the Americans with Disabilities Act (ADA) requirements.

1.10 WARRANTY

A. Provide manufacturer warranty for components and installer warranty for system function.

1.11 OWNER'S INSTRUCTION

A. Instruct Owner's representative in proper operation and maintenance procedures.

PART 2 – PRODUCTS

2.1 EQUIPMENT

A. Intrusion Alarm Devices:

1. Dual Motion Detector: C&K DT-6360STC – Ceiling Mount.

2. Motion Detector 60 foot range – Bosch ISC-PDL1-WA18 – Wall Mount.

3. Motion Detector 30 foot range – Bosch DS835i – Wall Mount.

4. Programmable Panic Switch: Ademco 269SN.

B. System Components

1. Head end enclosure: Custom built security panels with paver supplies, battery backup systems, wire management, testimonial strips, input, output, card reader, and control boards as required per location.

Hoffman A36N30ALP – 36 x 30, Hinged Cover

Hoffman A36N30MPP – Metal back plate for above

a. Snap Track to mount the Lenel boards.
b. Finger Duct for wire management:
https://www.panduit.com/en/products/wire-routing-management-protection/wiring-duct-accessories/wiring-duct-duct-covers/hn1_5x2lg6.html

Product Part #HN1.5X2LG6 Wire management.

Covers for finger duct: HC1. 5LG6

https://www.panduit.com/content/dam/panduit/en/products/media/9/19/419/5419/74125419.pdf

2. Power Supplies:

Altronix AL600ULAMCB (Two for every Hoffman box)

https://www.altronix.com/products/AL600ULPD8

3. Cabinet tamper switch for Hoffman boxes and power supplies:
a. GRI-TSC-20 For power supplies.
b. GRI-PB-2020 For Hoffman Boxes

4. Crash bar retrofit to electrified hardware. To make existing hardware electrified.

For Precision door hardware:
https://acsi-inc.com/product_category/1550-md-electric-motor-latch-retraction/

For Von Duprin door hardware:
https://www.commandaccess.com/vlp-ul-m-kit/

5. Card Reader type:

a. HID Signo 40, 40NKS-02-0016N6 Single Gang Switch Plate Reader
b. Signo 20, 20NKS-02-0016N6 Mullion Reader
c. HID Signo Keypad Reader Single Gang HOKNKS-02-0016N6.
d. All Exterior Doors use Keypad Reader

6. Door Locking Hardware:

a. Surface Mounted RimStrike HES9600

i. Furnish to best match door frame.
b. Surface Mounted RimStrike (Narrow openings HES-9400)
i. Furnish to best match door frame.
c. For all mortise: HES-1006
i. Furnish to best match door frame.
ii. For all other locksets: Adams Rite Ultraline Series 7400
d. RCI Maglock 8310
e. RCI Maglock Dual 8372
f. Securitron Maglock M32
g. Electrified Hinge Command Access Energy Transfer hinge GTM4WH4545-626 with 18 gauge wire.
h. Electronic Lever
i. Command Access. Match existing door levers and keying system.

7. Wiring:
A. Card access cable: Part # H91602-1A from Tappan.
Banana peel cable to all card readers Type CMP/CL3P Shielded plenum cable.
Yellow outer jacket color.
B. Alarm points: 22/4 non shielded cable – White
C. Com Bus between panels: Twisted 22/4 Shielded cable

8. Labeling required for panels. All labels should include the card reader/alarm point number as well as a short description.

9. Communication Equipment for Fire Panel and Intrusion Panel

a. DCS 4010 CF communicator, DSC LE4010CF-AT LTE UNIVERSAL COMMERCIAL FIRE ALARM COMMUNICATOR AT&T SIM CARD

b. DCS TL300 CF communicator, DSC TL300CF UNIVERSAL COMMUNICATOR
c. DCS TL280 CF communicator, DSC TL280LE-AT POWERSERIES NEO DUAL PATH LTE/IP ALARM COMMUNICATOR AT&T SIM (specifically for DSC panels)
d. Napco Cell Communicator, SLE-LTEVI-CFB-PS COMMERCIAL FIRE/BURG VERIZON DUAL PATH I, VERIZON or AT&T LTE NETWORK

10. Smart Control Integration – Kindoo
a. Provide a KIN D device for each controlled door.

11. Intrusion System - LENEL
a. Custom built-up LENEL panels as described below.
b. Door Contacts, Motion sensors, Glass break sensors, Water flood sensors, Panic buttons,

12. Lenel Panel Hardware:

a. Intelligent system controller

i. Lenel # LNL-3300X (ISC)

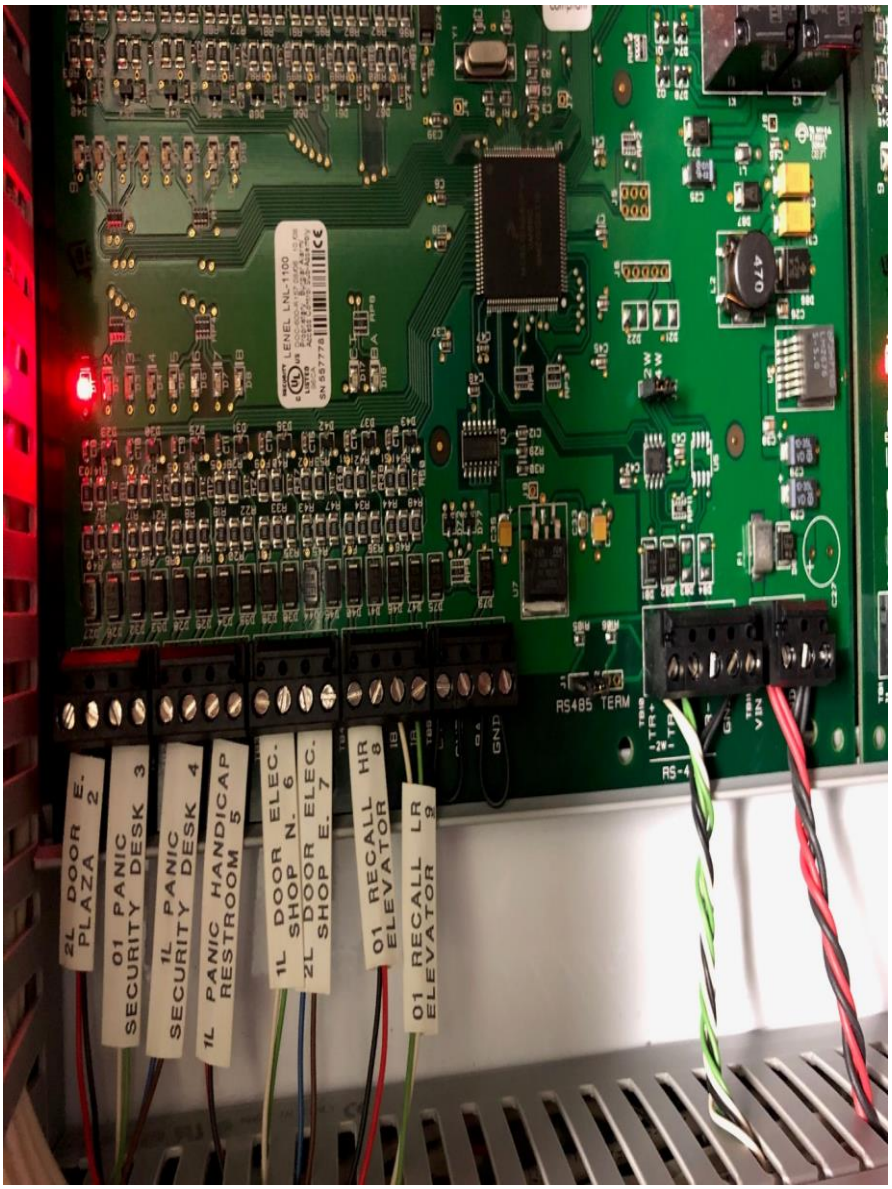
b. Card Reader Interface Module
   i. Lenel # LNL – 1320 Series 3. Dual Module. LNL-X2220

c. Lenel # LNL – 1300 Series 3. Single Module. LNL-X2210

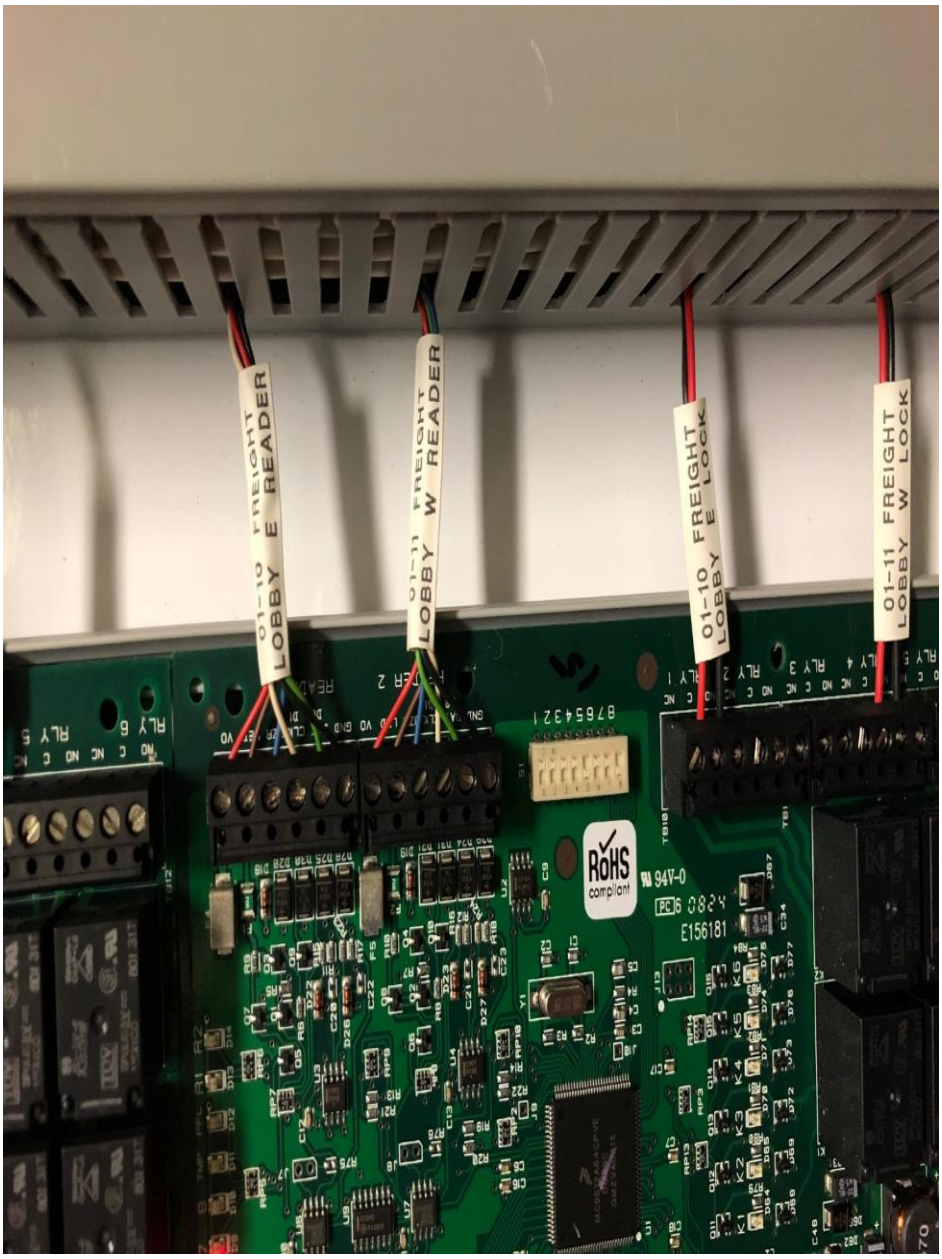
d. Output Control Module
   i. Lenel # LNL – 1200 SERIES 3.

e. Input Control Module
   i. Lenel # LNL – 1100. Series 3.

PANEL FABRICATION DETAILS



INPUT MODULE SCHOWING LABELING METHOD AND STANDARD



CARD READER CONTROLLER DETAIL

PANEL OVERVIEW DETAIL

NOTE: 36 X 30 Hoffman boxes allow 2 boards horizontally and 3 boards vertically.

TYPICAL SYSTEM DETAIL

NOTE: This shows power supplies and two typical panels.

C. Intrusion Alarm Power Requirements:

1. System Power: Standard 120 volts AC, 50/60 Hz power.

2. Control Primary Power: Transformer power shall be 16.5 VAC, 40 VA.

3. Backup Battery: Rechargeable 12 VDC, gel type, lead acid backup battery rated between 7 and 34-ampere Hours (AH).

4. Fusing: Protect battery input using PTC circuit breakers. Outputs shall be power limited.

D. Off-site Alarm Notification System:

1. Provide auto-dialer for intrusion detection system.

2. Owner will arrange for monitoring connection through the owner's Global Security Operations Center, a listed alarm receiving agency. Coordinate with LDS Church Project manager for set-up, programming and testing with GSOC.

3. Connect auto-dialer to standard telephone equipment line provided by local service provider.

2.2 MANUFACTUERS

A. Category Four Approved Manufacturers.

1. Lenel by United Technologies.

PART 3 – EXECUTION

3.1 APPROVED INSTALLERS

A. Same installer shall install Sections 28 13 01 Access Control, 28 16 01 Intrusion Detection, 28 23 01 Video Surveillance System, and 28 31 01 Fire Detection and Alarm System.

B. Approved installers:

1. Stone Security: Brent Edmunds at (801) 597-1720.

3.2 INSTALLATION

A. General:
1. All framed doors shall use electrified strikes. Exceptions must be approved.
2. Maglocks are only acceptable for gates or frameless doors.
3. Electronic levers are only used in unique circumstances and must be approved by the electronics and lock shop. When approved, Command Access electronic levers shall be used and must match the other hardware in the area. An electrified hinge must be used in conjunction with an electronic lever.

4. Each door with a card reader must have a request to exit motion sensor configured to disable the door position switch alarm when exiting from the non-card reader side of the door.
5. Cabling for doors below hard lid ceilings must be in conduit.
6. Provide a 4x4 back-box centered above door for request to exit motion detectors. Provide conduit to back-box adjacent to electric strike.
7. Provided 4x4 back box next to electric strike. Provide conduit to back-box above door.
8. All cabling exposed to potential damage must be run in ¾" or larger conduit.
9. Each card reader must be labeled. For labeling sequence numbering coordinate with Electronics Shop.

B. Conductors:

1. Install conductors in conduit.

2. Fire alarm system and security systems conductors from different zones may be combined in common conduit. Make certain that raceway size and wire quality, size and type is suitable for equipment supplied and is within NEC standards. Label pull and junctions 'FIRE ALARM' 'INTRUSION DETECTION' or 'VIDEO SURVEILLANCE' as appropriate.

3. Loop wires through each device on zone for proper supervision.

4. Minimum conductor size shall be 14 AWG unless otherwise specified.

5. Provide interface with Fire Detection and Alarm System.

3.3 FIELD QUALITY CONTROL

A. Manufacturer's Field Service:

1. Provide factory-trained representative to perform initial set-up and programming and to perform complete system testing and training in presence of Owner's representative upon completion of installation.

3.4 PROTECTION

A. Protect conductors from cuts, abrasion and other damage during construction.

B. Protect components from damage during construction.

END OF SECTION 281601

SECTION 32 3119 - DECORATIVE METAL FENCES AND GATES

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Decorative metallic-coated-steel tubular picket fences.

B. Related Requirements:

1. Section 03 3053 "Miscellaneous Cast-in-Place Concrete" for concrete.

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. Shop Drawings: For fencing and gates.

1. Include plans, elevations, sections, gate locations, post spacing, and mounting attachment details.
2. Gate Operator: Show locations and details for installing operator components, switches, and controls. Indicate motor size, electrical characteristics, drive arrangement, mounting, and grounding provisions.
3. Wiring Diagrams: Include diagrams for power, signal, and control wiring.

C. Samples: For each fence material and for each color specified.

1. Provide Samples 12 inches in length for linear materials.

1.4 INFORMATIONAL SUBMITTALS

A. Field quality-control reports.

B. Product Test Reports: For decorative metallic-coated-steel tubular picket fences, including finish, indicating compliance with referenced standard and other specified requirements.

1.5 CLOSEOUT SUBMITTALS

A. Maintenance Data: For gate operators to include in maintenance manuals.

1.6 QUALITY ASSURANCE

A. Installer Qualifications: Fabricator of products.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Wind Loading:

1. Fence Height: 0 to 15 feet.
2. Wind Exposure Category: C.
3. Design Wind Speed: 110.

B. Lightning-Protection System: Maximum grounding-resistance value of 25 ohms under normal dry conditions.

2.2 DECORATIVE METALLIC-COATED-STEEL TUBULAR PICKET FENCES

A. Decorative Metallic-Coated-Steel Tubular Picket Fences: Comply with ASTM F2408 for residential, light-industrial (commercial) application (class) unless otherwise indicated.

1. Basis-of-Design Product: Ameristar Perimeter Security; ASSA ABLOY; Montage Plus fence, 3-rail, Majestic style.

a. Subject to compliance with requirements, provide Basis of Design product, or a comparable product, approved by Architect prior to bid, by another Manufacturer.

B. Height: 3 feet.

C. Posts:

1. End and Corner Posts: Square tubes 2-1/2 by 2-1/2 inches formed from 0.108-inch nominal-thickness, metallic-coated steel sheet or formed from 0.105-inch nominal-thickness steel sheet and hot-dip galvanized after fabrication.

D. Post Caps: Formed from steel sheet and hot-dip galvanized after forming.

E. Rails: Square tubes.

1. Size: 1-3/4 by 1-3/4 inches.
2. Metal and Thickness: 0.079-inch nominal-thickness, metallic-coated steel sheet or 0.075-inch nominal-thickness, uncoated steel sheet, hot-dip galvanized after fabrication.

F. Pickets: Square tubes.

1. Pickets, rails and posts shall be pre-cut to specified lengths. Rails shall be pre-punched to accept pickets. Top rail shall remain unpunched.
2. Picket Spacing: 4 inches clear, maximum.

G. Fasteners: Manufacturer's standard concealed fastening system.

H. Metallic-Coated Steel Sheet: Galvanized-steel sheet or aluminum-zinc, alloy-coated steel sheet.

I. Interior surface of tubes formed from uncoated steel sheet shall be hot-dip zinc coated same as exterior.

J. Galvanizing: For components indicated to be galvanized and for which galvanized coating is not specified in ASTM F2408, hot-dip galvanize to comply with ASTM A123/A123M. For hardware items, hot-dip galvanize to comply with ASTM A153/A153M.

K. Finish exposed welds to comply with NOMMA Guideline 1, Finish #2 - completely sanded joint, some undercutting and pinholes okay.

2.3 MISCELLANEOUS MATERIALS

A. Welding Rods and Bare Electrodes: Select according to AWS specifications for metal alloy welded.

B. Concrete: Normal-weight, air-entrained, ready-mix concrete complying with requirements in Section 03 3000 "Cast-in-Place Concrete" with a minimum 28-day compressive strength of 3000 psi, 3-inch slump, and 1-inch maximum aggregate size or dry, packaged, normal-weight concrete mix complying with ASTM C387/C387M mixed with potable water according to manufacturer's written instructions.

C. Nonshrink Grout: Factory-packaged, nonstaining, noncorrosive, nongaseous grout complying with ASTM C1107/C1107M and specifically recommended by manufacturer for exterior applications.

2.4 METALLIC-COATED-STEEL FINISHES

A. Coating System:

1. Basis of Design: Ameristar Perimeter Security; ASSA ABLOY; E-Coat process, or equivalent approved by Architect prior to bid.

B. Galvanized Finish: Clean welds, mechanical connections, and abraded areas and repair galvanizing to comply with ASTM A780/A780M.

C. Surface Preparation: Clean surfaces of oil and other contaminants. Use cleaning methods that do not leave residue. After cleaning, apply a zinc-phosphate 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.

D. Duplex Cathodic Electrocoating: Immediately after cleaning and pretreating, apply manufacturer's standard two-coat finish consisting of epoxy prime coat and acrylic topcoat to a minimum dry film thickness of 2 mils. Comply with coating manufacturer's written instructions to achieve a minimum total dry film thickness of 4 mils.

1. Color and Gloss: Black

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas and conditions, with Installer present, for compliance with requirements for site clearing, earthwork, pavement work, construction layout, and other conditions affecting performance of the Work.

B. Do not begin installation before final grading is completed unless otherwise permitted by Architect.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Stake locations of fence lines, gates, and terminal posts. Do not exceed intervals of 500 feet or line of sight between stakes. Indicate locations of utilities, lawn sprinkler system, underground structures, benchmarks, and property monuments.

1. Construction layout and field engineering are specified in Section 01 7300 "Execution."

3.3 DECORATIVE FENCE INSTALLATION

A. Install fences according to manufacturer's written instructions.

B. Install fences by surface mounting as indicated and fastening rails to posts.

C. Post Setting: surface mount

1. Verify that posts are set plumb, aligned, and at correct height and spacing, and hold in position during setting with concrete or mechanical devices.

2. Space posts uniformly as per drawings with a max 5’ spacing.

3.4 REPAIRS

A. Touchup Painting:

1. Immediately after pedestal erection, clean bolted connections and abraded areas. Paint uncoated and abraded areas with similar material of same color as used for powder coat 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.

END OF SECTION 32 3119

SECTION 32 8400 - IRRIGATION

PART 1 - GENERAL

1.1 SUMMARY OF PROJECT

A. The work covered by this section of the specifications consists of furnishing all labor, material, equipment and supplies in performing all operations in connection with the irrigation system and all site work in strict accordance with this section of specifications and applicable drawings.
B. The purpose of this project is to provide the owner with a HydroPoint WeatherTRAK controlled irrigation system.
C. Any material specified by name and/or model number in the specifications is deemed to be used for the purpose of identifying the materials and insuring the specific use of that material in the construction.
D. Submit Contractor's construction schedule of anticipated work time to facilitate timely visits for review of work.
E. Work to be done on Project shall:

    1. Include all labor, materials, equipment, tools and transportation.
    2. Perform all operations, in connection with and reasonably incidental to; the complete installation of the irrigation system.

F. Items of work specifically included.

    1. Procurement of all applicable licenses and permits.
    2. Payment of any fees for connection to water source and power source.
    3. Coordinate of location of underground utilities, by contacting local services: ‘Blue Stakes’ or ‘Call Before You Dig’.
    4. Sleeving necessary for irrigation pipe and wire.
    5. Provision for and connection of the electrical power supply to the irrigation control system.
    6. One year warranty of all irrigation components and all labor required to install.
    7. 90 day maintenance period of irrigation system and components.

G. All disturbed areas shall receive irrigation unless specifically indicated on drawings.

1.2 DEFINITIONS

A. CD’s: Acronym for Construction Documents. Design /Build documents created and supplied by the Contractor for the purposes of building the irrigation system.
B. Contract: For the purposes of the irrigation section of the specification, (Section 32 84 00) this term refers to the Contract, Sub-Contract, or portion of the Contract dealing only with the irrigation system.

C. Contractor: For the purposes of the irrigation section of the specification this term refers to the specific contractor or sub-contractor responsible for installation of the irrigation system for this project.
D. GPM: Acronym for Gallons per Minute.
E. Isolation Valve: A manual valve located on the main line that when shut off, will remove constant pressure to a specific section of the main line and corresponding downstream irrigation components.
F. Line Valve: A manual valve located on the main line that when shut off, restricts flow in the main line. More than one line valve must be shut off to isolate a section of main line and corresponding downstream irrigation components.
G. Lateral Line Piping: Circuit piping downstream of remote control valve (RCV) providing water to sprinkler heads, bubblers, or drip components. Under pressure only when RCV activated and opened.
H. Line Voltage Wiring: Wiring used to convey power to electrically operated equipment on the Project, such as 120 VAC, 240 VAC, or 480 3PH VAC.
I. Low Voltage Wiring: Wiring used to convey power to irrigation system components, such as RCV's, master valve, flow meter, decoders, etc. An example would be: 14 AWG PE UL RCV control wire.
J. Main Line Piping: Piping downstream of Point of Connection (POC). Provides water to RCV's, Quick Couplers, and hose bibs. Normally under constant pressure.
K. OAR: Acronym for Owner's Approved Representative. This individual designated by Owner who is authorized to make decisions on behalf of the Owner. This individual is authorized by the Owner to direct actions of the Contractor. This individual shall have detailed involvement in the project and be on Project site at regular intervals.
L. POC: Acronym for Point of Connection. The physical location of the water source for this Project, and the actual components installed connecting to the water source. May require Contractor to provide additional saddles, valves, nipples, fittings, spools etc. to provide water to the Project.
M. RCV: Acronym for Remote Control Valve. An electrically operated 24 VAC valve.
N. Static Pressure: Pressure measured at the POC, with no flow taking place within the system.
O. Water Supply: Potable, and/or Non-Potable, and/or Effluent piping and components, furnished and installed by trades or contractors other than the irrigation contractor; to provide irrigation water to this Project upstream of (prior to) the POC.

1.3 ELIGIBILITY TO BID

A. The minimum level of expectation for Experience and Qualifications required to be eligible to bid the irrigation system on this Project are listed below in this section.

1. See Sections referring to 'Experience, Qualifications and Certifications' for more information and details.

2. Contractor shall be in compliance with these requirements at the bid date.

B. Contractor shall be prepared to submit documentation supporting their Experience and Qualifications to the General Contractor and the Owner's Approved Representative, (hereafter referred to as the OAR) within 48 hours of bid date.

C. Failure to meet the minimum requirements for Experience and Qualifications may result in elimination of the Contractor's bid or his ability to work on this Project.

D. Failure to provide supporting documents within 48 hours of bid may result in elimination of the Contractor's bid or his ability to work on this Project.

E. Requirements for documentation of Certifications are also listed below in the same Section. Contractor shall not be required to submit documentation of Certification at Bid date, but at date indicated.

1.4 PROJECT CONDITIONS

A. Contractor shall accept Project site in 'as-is' condition.

B. Emergency Interruption of water service.

1. In the event irrigation installation requires emergency shut-down of the municipal water system, Project site or development water system, or Project's irrigation system. Contractor shall be responsible to notify OAR and governing agency immediately. Contractor shall make every effort to restore service in a timely manner.

C. Planned Interruption of water service

1. In the event irrigation installation require shut-down of municipal water system(s), Contractor shall be responsible to coordinate with and receive approval from the OAR and local governing agency. Contractor shall be responsible for notification of any affected properties as directed by the local governing agency. In no case shall notification be less than 48 hours in advance of shut down, nor shall the shut-down extend beyond 8 hours.

D. Contractor shall be responsible for continuous provision of irrigation water maintaining all existing or new plant material on Project in a healthy condition during term of this project.

E. Contractor shall maintain Project work area in a safe condition, and provide flagging, taping, barricades, trench covering, shoring and or fencing necessary to maintain safety.

1.5 PERFORMANCE REQUIREMENTS

A. Minimum pressure and minimum flow required:

1. Performance Specifications expect that the Contractor access or provide a POC that has available a minimum static pressure and a minimum flow capable to safely and efficiently operate irrigation system.
2. Contractor shall perform static/working pressure and volume test within 48 hours of commencement of work, and provide written results to OAR.

B. Responsibility for coverage:

1. Performance Specification design intends that the Contractor shall provide 100% coverage of sprinklers (also known as double coverage or head-to-head coverage.)
2. Contractor shall have authority to make minor adjustments to actual placement of sprinkler heads or irrigation components vs. locations shown on plan, in order to best achieve full coverage indicated above, without significant overspray on hardscapes, buildings or other project features.
3. Contractor shall notify OAR in writing of: potential discrepancies or weaknesses due to field conditions in implementing irrigation design.

C. Layout of Components

1. During layout and staking, consult with OAR to verify proper placement of major irrigation components.
2. Contractor shall not proceed with implementation of irrigation plans without OAR's approval.
3. Contractor shall have authority to make minor adjustments to pipe routing or equipment locations due to conflicts with site utilities or other obstructions.

1.6 SEQUENCING

A. Contractor shall contact local utility locator service at least 48 hours prior to commencement of work on the Project, and as often as needed during progress of the Project to maintain Project safety and protection of site utilities.

B. Contractor shall familiarize himself with site utilities and hazards prior to commencement of work.

C. Contractor shall coordinate this work with other work by other trades on Project as well as other landscape tasks on Project.

D. Install sleeving prior to installation of concrete flat work, paving or other permanent site elements as needed.

E. Irrigation system Point of Connection components, backflow prevention shall be installed and operational prior to all downstream components.

F. All main lines shall be thoroughly flushed of all debris prior to installation of Remote Control Valves.

G. All lateral lines shall be thoroughly flushed of all debris prior to installation of any sprinkler heads.

1.7 REFERENCE / RELATED DOCUMENTS

A. The Specification General and Supplementary General Conditions of the Specifications shall apply to all work under this section.

B. Separation of these specifications into sections is for convenience only and is not intended to establish limits of work.

C. Work under this section shall include coordination with all other sections of these specifications.

D. The following references apply to this project, the Contractor shall be responsible to be familiar with, refer to, and implement these references in completion of this project:

1. ASTM – American Society for Testing and Materials.
2. Irrigation Association: Turf and Landscape Irrigation Best Management Practices (BMPs).
3. American Society of Irrigation Consultants (ASIC) ‘ASIC Guideline 100-2002 (January 2, 2002) For Earth Grounding Electronic Equipment in Irrigation Systems.
4. Utah Irrigation Professionals document: Minimum Standards for Landscape Design and Construction.
5. Any local governing agency codes, ordinances and/or any standards, details and specifications for irrigation applicable agency may have.
6. Applicable industry codes, ordinances or standards such as (but not limited to) UBC or NEC.

1.8 SUBMITTALS

A. Contractor shall follow format and requirements as set forth in Submittals section of this specification document for materials submittals.

B. Contractor shall provide submittal for irrigation equipment and materials prior to ordering or taking delivery of any products.

C. Equipment or materials purchased or installed prior to receiving written submittal approval is at risk of rejection by OAR. Use of materials other than those approved in writing is at risk of

rejection by OAR. Contractor shall be liable for removal or replacement of any or all non-approved products at his own expense.

D. Contractor shall provide OAR with 2 copies of Operations and Maintenance manual, containing:

1. Copy of approved submittal products
2. Detailed written instruction for Spring Start-up and Winterization.
3. Site map showing Controller zones, each zone distinguished by a different color.
4. Table showing typical Controller program schedule for worst case day.
5. Copy of control system certification if required for this Project.
6. Copy of water audit results if audit is required for this Project.
    a. Copy of water audit certification when Project has met required criteria.

1.9 EXPERIENCE

A. Contractor shall provide an Experience resume or document; in pdf format, indicating:

1. That Contractor is licensed to perform landscape and irrigation construction in the State where this Project resides.
2. That Contractor is bondable and insured for the work to be performed.
3. That Contractor has been installing sprinkler systems on commercial projects for the last five consecutive years.
4. References of five projects of similar scope and size completed within the last five years. Three of the projects listed shall be local.

1.10 QUALIFICATIONS

A. Contractor shall provide a Qualifications resume or document; in pdf format indicating:

1. That Contractor currently employs both skilled and unskilled workers in sufficient quantities to complete project within time limits indicated by Contract.
2. A list of employees to be assigned to this project and their irrigation experience.
3. That Contractor possesses proper power equipment of appropriate size and quantity to complete project within time limits indicated by Contract.
4. Contractor shall include a listing of the supplier(s) where irrigation related material will be purchased for this Project.
5. Person on project site, in charge (Project Foreman, Superintendent, Supervisor, Manager--etc.) of daily irrigation field construction operations:
    a. Has at least five consecutive years of commercial irrigation experience.
    b. That this person is able to communicate with OAR. Is fluent in reading, writing and speaking English.
    c. That this person is able to communicate rapidly and effectively with his staff in any languages used within his staff.

d. Is a Certified Irrigation Contractor (CIC) in good standing as set forth by the Irrigation Association. This person shall be on the project site at least 75% of each working day.

i. Contractor's CIC shall be a regular full-time employee of the Contractor firm, **or** a sub-contractor to Contractor, where sub-contractor's firm provides **all** irrigation installation for the Project and meets all listed requirements for Experience, Qualifications and Certifications.

B. NOTE: Contractor shall not engage a CIC as a consultant or representative to oversee Contractor's staff install the Project irrigation system, i.e. the Contractor shall not 'rent' a CIC or CIC's license

1.11 CERTIFICATIONS

A. Contractor shall provide copies of appropriate Certification documents for all applicable staff. In order to provide a minimum level of workmanship, all installation personnel expected to perform any tasks involving PVC pipe, electrical components, and or drip components; shall have Certificates for each task they perform as designated below:

1. All installation personnel who will work on PVC pipe and PVC fittings in the irrigation system shall be certified by IPS Corporation. The certification shall cover PVC pipe and fitting assembly using solvent weld joining techniques. It is the responsibility of the Contractor to obtain such certification and to provide a copy of the "Certificate of Completion" for each person handling PVC products on the project to the OAR prior to commencement of work. It is the Contractors responsibility to contact IPS Corporation and then the local IPS authorized representative well in advance of commencement of work to schedule his/her attending of a scheduled seminar or to make an appointment to schedule a new seminar. Contact IPS Corporation, Weld-On Customer Service at 800 421-2677, to obtain a referral for the local IPS factory authorized representative contact information.

2. All installation personnel who will work on the electrical circuits of the irrigation system shall be certified by Paige Electric Co. The certification shall cover irrigation wires, cables, proper installation and splicing methods, and protecting electronic equipment from lightning and power surges. It is the responsibility of the Contractor to obtain such certification and to provide a copy of the "Certificate of Completion" for each person installing electrical products on the project to the OAR prior to commencement of work. It is the Contractors responsibility to contact Paige Electric well in advance of commencement of work to schedule his/her attending of a scheduled seminar or to make an appointment for a new one. Contact Vince Nolletti, Vice President Irrigation Operations, Paige Electric Co, LP, 559 431-2346.

3. If Drip irrigation products are to be used on this Project, all installation personnel who will work on drip components of the irrigation system shall be certified by the manufacturer of the corresponding drip products specified to be used on the Project. The certification shall cover proper application and installation of point source and inline drip irrigation products, and also adaptation of drip product to Project soil types and infiltration rates. It is the responsibility of the Contractor to obtain such certification and to provide a copy of the "Certificate of Completion" for each person installing drip products on the project to the OAR prior to commencement of work. It is the Contractors responsibility to contact the drip product manufacturer and the local manufacturer's authorized representative well in advance of commencement of work to schedule his/her attending of a scheduled seminar or to make an appointment for a new one. Courtesy contact information for the following manufacturers is shown below:

    a. Rain Bird Corporation—Tiffany Haveron (435) 720-3897
    b. Hunter Industries—Ryan Bushman (385) 232-5730
    c. Netafim USA—Kelly Keicher (303) 513-3738

4. Documents verifying certifications for the following shall be provided to OAR through the General Contractor at least 7 days prior to commencement of any irrigation work on the Project:

    a. PVC Solvent Weld certification
    b. Electrical certification
    c. Drip certification

1.12 CERTIFICATION FOR NON-TRADITIONAL OR CENTRAL CONTROL SYSTEMS

A. If non-traditional and/or central control equipment or products are to be used on this Project, including but not limited to:

    1. 'SMART' controllers,
    2. Decoders and two wire systems,
    3. Weather-based systems, AND/OR
    4. Soil moisture sensors.

B. Contractor shall provide copies of appropriate Certification documents for all applicable staff. In order to provide a minimum level of workmanship, all installation personnel expected to perform any tasks involving non-traditional and/or central control equipment shall have Certificates for each task they perform as designated below:

1. All installation personnel who will work on the specific system, equipment or product shall be certified by the manufacturer of the corresponding products to be used on the Project.
2. The certification shall cover proper application and installation of these products, and also adaptation of the products to this specific Project.
3. It is the responsibility of the Contractor to obtain such certification and to provide a copy of the "Certificate of Completion" for each person installing these products on the project to the OAR prior to commencement of that portion of work.
4. It is the Contractors responsibility to contact the product manufacturer and the local manufacturer's authorized representative well in advance of commencement of work to schedule his/her attending of a scheduled seminar or to make an appointment for a new one.

C. Local Distributor, Manufacturer's Representative or Manufacturer are authorized to withhold sales or delivery of non-traditional equipment until such time that the Contractor demonstrates adequate understanding of assembly, installation, programming, operation, and maintenance of the equipment.

1.13 QUALITY ASSURANCE

A. Inspection Scheduling

1. Contractor shall expect a minimum of five irrigation inspections under the direction of the OAR.

    a. Main Line pipe and wire
    b. Main Line pressure test
    c. Progress inspection
    d. Final inspection
    e. Completed 'Punch List' inspection

B. Main Line Piping

1. Main line pipe shall not be buried until approved by OAR. Pipe buried prior to approval shall be excavated and exposed for OAR's review.
2. Upon completion of main line pipe or sections thereof, Contractor shall isolate and pressurize to 120 PSI for two hours.
3. Contractor shall provide OAR with 48 hours request prior to testing date and time.

C. Grounding Resistance Testing

1. Controllers shall be tested by Licensed Electrical Contractor and show resistance of 10 Ohms or less.

2. Grounding not in compliance shall be corrected by Contractor at his expense.
3. Specific grounding requirements for Central Control systems shall be met by Contractor or corrected at his expense.

D. Project Record Copy

1. Maintain on Project site, one copy of all CD's clearly marked 'Project Record Copy'. Mark any deviation in material installation on CD's. Maintain and update sheets at least weekly.
2. Project Record Copy shall be available to OAR on demand.

E. Regulatory Requirements

1. Contractor shall comply with all plumbing requirements which direct work to be done by a licensed plumber.
2. Contractor shall comply with all electrical requirements which direct work to be done by a licensed electrician.
3. All work and materials shall be according to any and all rules, regulations or codes, whether they are local, state or national requirements.
4. Performance Specifications may not be construed or interpreted to permit work or materials not conforming to the above codes.

F. Adequate Water Supply

1. Water supply to this Project may be existing, or also may be installed by trades other than the Irrigation Contractor. Connection to this supply at the POC shall be by this Contractor. Contractor shall be responsible to verify that proper connection exists, and is of adequate size and pressure.
2. Notify OAR verbally immediately and in writing within 48 hours of problems encountered with water supply.

G. Workmanship and Materials

1. It is the intent of the Irrigation Specifications that all material required shall be of the highest quality available and meeting the requirements specified.
2. All work shall be performed in accordance with the best standards of practice relating to this trade.

1.14 PROJECT MATERIALS

A. Owner shall retain option to purchase materials to be used on Project and provide them to Contractor.

B. Contractor shall not remove materials purchased for this Project from this site.

C. Contractor shall not store or co-mingle materials for this Project with materials for other Projects on this site.

D. Delivery, Storage and Handling

1. All materials shall be protected from contamination, damage, theft, vandalism, and prolonged exposure to sunlight.
2. All material stored on project site shall be neatly organized in a compact arrangement, and this storage shall not disrupt project owner or other trades on Project site.
3. Project materials shall be handled by Contractor with care necessary to prevent damage or breaking.
4. Damaged or blemished materials attributed to Contractor shall be replaced with new, at Contractors expense.

E. If this Project qualifies for manufacturer rebate, credit or incentive programs; Contractor shall provide OAR with documents in pdf format from distributor and/or manufacturer indicating required information of product purchased and/or dollar value which qualify for corresponding program. Documents shall be delivered to OAR within 14 days of purchase of products.

1.15 EXTRA MATERIALS

A. Furnish the following items to OAR:

1. One (1) 30” gas cock key (also referred to as sprinkler or meter key) for manual drains.
2. One (1) 5-6’ key for stop & waste valve.
3. One (1) 5-6’key for 2” square operating nut valve.
4. Two (2) keys for each automatic controller.
5. Two (2) quick coupler keys with hose swivels attached.
6. One (1) quick coupler valve.
7. One (1) of each size or type of remote control valve used on Project.
8. Five (5) of each sprinkler head and each nozzle used on Project.
9. Two (2) of each type of specialty screwdriver/key/wrench/tool (used to adjust arc, radius, change nozzle etc.) for each type of sprinkler.

1.16 WARRANTY

A. Contractor shall provide one-year Warranty for Project. Warranty shall cover all material, workmanship, and labor.

B. Warranty period begins upon date of acceptance by OAR that Project is substantially complete.

C. Warranty shall include filling and/or repairing depressions, replacing turf or other plantings due to settlement of irrigation trenches or irrigation system components, and adjustment of valve boxes, sprinkler heads and all other irrigation components which have settled from proper finish grade.

1.17 ADDITIONAL SERVICES

A. Winterization:

1. Contractor shall winterize entire irrigation system installed under this Contract prior to the first winter following installation; prior to hard frost--but no later than November 15th, unless directed otherwise by OAR in writing.
2. Winterize entire system via 'blow-out' method, using compressed air.
    a. Compressor shall be industrial type, capable of evacuating water from all main line and lateral line pipe, with a minimum capacity of 175 CFM.
    b. **Compressor shall be mechanically regulated to not more than 60 PSI.**

B. Spring Start-up:

1. Contractor shall start up entire irrigation system the Spring following installation; prior to plant need--but following danger of damaging frost, yet no later than April 1st.
2. Contractor shall energize entire main line pipe, all RCV's, and check for correct program installation and operation of Controller, each RCV and each quick coupler valve.

C. As-built documents: Prior to final inspection, prepare and submit to OAR As-built drawings.

1. Show field dimensioned locations of sleeving, POC, mainline piping, wiring runs not in main line pipe trench, and valves/valve boxes.
2. Dimensions are to be taken from permanent site features or finished hardscapes.

D. Central Control system and equipment shall be inspected by Factory authorized technician and commissioned by the same. Equipment shall be turned over to OAR in programmed and operating condition.

1.18 OWNER'S INSTRUCTION

A. After system is installed, inspected, and approved; Contractor shall instruct OAR or other OAR designated individuals in complete operation and maintenance procedures of irrigation system. Coordinate instruction with references to previously submitted Operation and Maintenance manual.

1.19 COORDINATION

A. Coordinate and cooperate with other Contractors as necessary to enable the work to proceed as rapidly and efficiently as possible.

1.20 INSPECTION OF SITE

A. The Contractor shall be acquainted with all site conditions. Should utilities not shown on the plans be found during excavations, immediately notify the Engineer. Failure to do so will make the Contractor liable for any and all damage thereto arising: from his/her operations subsequent to discovery of such utilities not shown on plans.

1.21 EXISTING UTILITIES

A. Before any trenching, excavation or digging below the surface for any reason is begun, the Contractor shall have the area "Blue Staked" in order to determine as close as possible the location of all underground utilities. The Contractor shall have a representative of the airport locate any airport or FAA underground utilities. The Contractor will conduct the work in such a manner to protect all utilities from damage. It is the responsibility of the Contractor to repair or replace any damage incurred by the Contractor or the Contractor's employees at no expense to the owner.

1.22 PROTECTION OF EXISTING SITE CONDITIONS

A. The Contractor shall take necessary precautions to protect site conditions to remain. Should damage be incurred, the Contractor shall repair the damage to its original condition at the Contractor's own expense.

1.23 SUBSTANTIAL COMPLETION

A. The date of Substantial Completion for the irrigation system will be when the complete irrigation system is working as intended. This will be determined by observation by the Engineer and Owner's Authorized Representative. The Contractor shall supply the owner or owner’s agent, at this inspection, with complete 'Record Drawings', written suggested start- up and shut-down procedures.

1.24 GENERAL CONDITIONS

A. All work performed shall reflect a total "turn-key" installation. This would include all equipment and materials necessary to install new controllers, all necessary wiring, communications equipment and communication lines needed to for a completely functional irrigation control system.

B. Include the installation of master valve and flow sensor at point of connection. These valves and sensors shall be connected just downstream of the backflow preventer.

C. Provide first year backflow testing and certification for new backflow preventers to the Engineer.

D. The Centralized Irrigation Control System shall be warranted to be free of defects and properly installed for one (1) year from the date of final acceptance. All equipment shall have a manufacturer's guarantee against faulty design, improper assembly, defective workmanship, or defective materials for a period of one (1) year from final acceptance.

PART 2 - PRODUCTS

2.1 GENERAL

A. Pipe and materials installed throughout the system shall be new and in satisfactory condition. After award of the contract and prior to beginning work, the Contractor shall submit for approval a complete list of materials that he/she proposes to install. No deviations from the specifications shall be allowed, except as provided for in these documents.

2.2 POWER SOURCE

A. Power source for irrigation equipment shall not be included in the irrigation Contractor’s portion of this Contract.

B. Control System Components

1. Irrigation Control System Hardware and Software. The Irrigation Control System shall be HyrdoPoint WeatherTRAK WTOXR-C-18-SPH, as per drawings.
2. Data Communication
    a. Communication Wire between Controller and Flow Sensor shall be as recommended by manufacturers.

C. Grounding Systems

1. #6 AWG solid bare copper wires.
2. Copper ground plate 4 inches wide, 96 inches long, 0.0625 inches thick with 25 feet continuous length of 6 AWG solid bare copper wires attached by the manufacturer.
3. Copper clad steel ground rod 5/8 inch diameter, 10 feet long, UL listed.
4. Cadweld GRl161 G 'One-Shot' welding kit.
5. Power Set earth contact material by Paige Electric. 1-800-327-2443
6. Ground network shall be 10 ohms or less when tested.

D. Flow Sensors and Accessories

1. As noted on drawings with the following accessories:
    a. Direct burial Paige Wire PE-39 or PE-89 20 AWG cable or approved equal.
    b. Wire Connector Kits, 3M DBR/Y-6 or DBO/B-6

2.3 POWER WIRE

A. Direct bury wire for field located wall or pedestal mounted controllers:

1. All power cables shall be Paige Wire, type Tray Cable.
2. Wire shall be Paige Wire specification number P7266D for 10 AWG and smaller.
3. Wire shall be Paige Wire specification number P7267D for 8 AWG and larger.
4. 120 VAC wires shall be 3 conductor (hot, neutral and ground)
5. 240 VAC cables where service is provided to **controller only**, shall be 3 conductor (2 hot and 1 ground)
6. 240 VAC cables where service is provided to controller **and** other 120 VAC equipment (such as a convenience outlet) shall be 4 conductor (2 hot, 1 neutral and 1 ground)

B. Conventional wiring for wall mounted controllers:

1. Power wire or cable for conventionally wired wall mount or conduit-fed pedestal mount shall be according to local and NEC codes.

2.4 CONTROL WIRE

A. Remote Control Valve wire shall be Paige Electric specification number P7354D – Rev 4.

B. Different colored jackets shall be used for each controller on project.

C. For projects with more than one controller, a separate color of 14 AWG wire (other than white, yellow, red or blue) shall be used as the ‘hot’ or ‘control’ wire for each additional controller.

2.5 WIRE CONNECTORS

A. RCV wire splicing connectors shall be Paige P7364D, Paige part number 270670 or 270671 (3M model ‘DBR/Y-6’). **No substitutions allowed.**

B. Communication wire splicing or connection shall be Super Serviseal model 8006137. Contractor may submit to OAR; alternate: Paige brand, model 273211 (3M model SliC) and Paige brand, model 270228R (3M model 316IR)**. No use of alternate without written approval from OAR.**

2.6 POINT(S) OF CONNECTION

A. Contractor shall be prepared for a variety of POC conditions including:

1. Tapping, Saddling, Pac-Joint connection, extension, flared end connectors.

2.7 BACK FLOW PREVENTER

A. Febco 825YA, see drawings.

B. Aluminum, solid wall, insulated cabinet, as manufactured by VIT Strong Box.

2.8 HYDROMETER

A. Netafim Photo Diode Register.

2.9 SLEEVING PIPE

A. Minimum sleeve size shall be 2” pipe.

B. Sleeving 2” through 4” shall be S/40 PVC pipe. Sleeving 6” and larger shall be CL/200 PVC pipe.

C. Sleeves shall typically be two nominal sizes larger than the pipe to be placed within them. Sleeve material and sizes shall be according to the following

D. SLEEVING TABLE:

INTERIOR PIPE	SLEEVE PIPE		INTERIOR PIPE	SLEEVE PIPE
¾” S/40	2” S/40		4” CL/200	8” CL/200
1” S/40	2” S/40		6” CL/200	10” CL/200
1-1/4” S/40	2-1/2” S/40		8” CL/200	12” CL/200
1-1/2” S/40	3” S/40		10” CL/200	14” C905
2” S/40	4” S/40			
3” S/40	6” CL/200			

2.10 TRENCH BEDDING MATERIAL

A. Bedding material shall be a sandy material free of rocks over 1 inch in diameter. Where existing soil does not meet this requirement, approved imported material shall be used.

2.11 PIPE PLUGS AND MARKERS

A. Inside Sealing Pipe Plug - High impact polystyrene plastic retainers, rubber meeting ASTM C443, and corrosion resistant plated metal parts.

B. Sleeve Marker Stake - 2x4 wood 24 inch minimum length. Painted green.

2.12 MAIN LINE PIPE

A. Pipe 3/4" through 1-1/2" shall be S/40, solvent weld-bell end.
B. Pipe 2" through 3" shall be CL/315, solvent weld-bell end.

2.13 MAIN LINE FITTINGS

A. All main line fittings 2-1/2" and smaller shall be S/80.

B. All main line fittings 3" and larger shall be gasketed ductile iron.

1. Ductile iron fittings shall be manufactured by Harco, Leemco or OAR approved equal.

2.14 JOINT RESTRAINT SYSTEMS:

A. Concrete Thrust Blocks

1. Provide thrust blocks on mainlines at any change of direction (for slip joint fittings).
2. Concrete shall have compression strength of 2500 PSI.

B. Pipe Bell Joint Restraint components shall be tested and certified to meet the requirements of ASTM F1674 and shall be manufactured by Harco or Leemco. Grip ring serrations shall be machined. Restraint rods, bolts, and nuts shall be of ductile iron or low alloy steel.

C. Valve to Fitting Restraint shall consist of a ductile iron (ASTM A536) split ring that fits behind the bell of the valve and threaded rod ending in an eye-bolt and nuts that fit onto the lugs of the fitting and shall be supplied by Harco or Leemco.

D. Valve to Pipe Restraint shall consist of a ductile iron (ASTM AS36) split ring that fits behind the bell of the valve and a ductile iron split ring with machined serrations that grips the pipe and shall be supplied by Harco or Leemco.

2.15 MANUAL CONTROL VALVES

A. Line or isolation valves 2" and smaller shall be:

1. Apollo 77CLF10XXX. Or OAR approved equal.

B. Isolation valves for RCV Manifolds (1" through 2-1/2") shall be:

1. Apollo 77C-10X-01 bronze ball valve Or OAR approved equal.

C. Drain Valves shall be:

1. ¾” Mueller Oriseal model H-10288.

2.16 QUICK COUPLER VALVE

A. Rain Bird 5LRC 1 inch brass quick coupling valve. On manufacturer assembled O-ring swing joint with threaded brass insert.

2.17 CONTROL VALVES

A. Automatic control valves shall be Rain Bird PEB Series electric remote control valves, size appropriate for sprinkler zones.
B. All Automatic control valves shall have Action Machining, Inc. manifold systems as per detail. All 2 inch valves shall have 2 inch action manifolds, all 1-1/2 inch – 1 inch valves shall have 1-1/2 inch action manifolds.

2.18 VALVE BOXES

A. Carson Industries Specification Grade valve boxes, ‘T’ top configuration.

B. Box, lid color to be brown, tan, or gray or green to match adjacent bark or stone mulch color.

2.19 LATERAL PIPE

A. All lateral piping 3/4" through 1-1/2” shall be new, S/40 PVC, solvent weld bell end. Sized as indicated on plans.
B. All lateral piping 2” through 3” shall be new, CL/315 PVC, solvent weld bell end. Sized as indicated on plans.

2.20 LATERAL LINE FITTINGS

A. First two fittings downstream of control valve manifold shall be S/80

B. All other lateral line fittings shall be new S/40 PVC.

2.21 ROTARY HEAD SPRINKLERS

A. Nozzles for spray heads shall be required for area covered and proper spacing.

B. All rotary heads shall be on a swing joint assembly composed of: 12-24" of swing pipe, two ½" spiral barb elbows, 12-24" swing pipe, one M412-005 ½" marlex street elbow.

C. Contractor shall submit for approval: rotary heads, rotary head nozzles, and swing joint assembly components.

2.22 DRIP EMITTER EQUIPMENT

A. All drip emitters shall be as specified herein and described in the details.

B. Rain Bird XCZ-100-PRB-COM wide flow drip control zone kits.

C. Rain Bird Landscape Drip Line: Netafim TLCV-06-12, 0.6 GPH emitters spaced 12 inches apart.

D. Netafim compression fittings compatible with Drip line.

E. Hunter Drip Indicator: Hunter ECO ID

F. Netafim Flush Valve: TLSOV

G. Contractor shall submit for approval.

PART 3 - EXECUTION

3.1 GENERAL

A. Contractor shall repair or replace work damaged by irrigation system installation.

B. If damaged work is new, Contractor shall engage original installer of that work to perform repairs.

C. Plant material deemed damaged by OAR shall be replaced at Contractor's expense.

D. Contractor shall route pipe, wire, and other irrigation elements around outside of tree canopy drip line to minimize damage to tree roots.

E. Contractor shall not cut existing tree roots larger than 2" to install this Project.

F. Coordination of trench and valve locations shall be laid out with OAR prior to any excavation occurring.

G. Contractor shall have no part of existing irrigation system used by other parts of Project landscape without water for more than 48 hours.

H. The Contractor prior to installing the system, must verify existing water pressure and volume. If there is a failure to obtain the needed pressure or if an excess of pressure exists for normal operation, the contractor shall contact the Engineer for any adjustments to the system. Failure to report any discrepancies in pressure due to whatever reason, and installation done prior to notification of Engineer shall be done at the expense of the Contractor.

I. Verify site conditions and note irregularities affecting work of this section. Report irregularities to the Engineer prior to beginning work. Verify locations of underground utilities including the existing irrigation system components and control wire in areas where excavation is to occur.

J. Layout work as accurately as possible. All irrigation lines shall be installed in common trenches where possible. Where possible, all trenching shall occur on soft spaces.

K. Stake out the irrigation control system. Items staked out are to include: controllers, sleeve locations, control wire, central control system wire routing, master valve/flow sensor locations, and electrical power wire routing.

L. Irrigation system layout review will occur after the layout has been completed. Notify the Engineer 2 days in advance of review. The Engineer at this review will identify modifications.

M. If for any reason complete coverage of all irrigation areas does not cover; irrigation Contractor shall be responsible to contact the Engineer before continuing with his work.

N. Any Major Revisions to the irrigation system must be submitted and answered in written form, along with any change in contract price.

O. Install all irrigation systems as per State and Local codes.

3.2 CENTRAL CONTROL SYSTEM

A. All clocks shall be as specified on the drawings and installed according to the details. Ground controller system as per manufacturer's recommendations. Exact location of clock shall be determined on site by the OAR.

B. Irrigation Control Units: The locations of the control units depicted on the drawings are approximate; the owner's representative, with assistance from the manufacturer's representative, will determine the exact site locations at the system layout review.

C. Owner will provide all telephone drop locations as designated on plans. Contractor is responsible for all connections from that point. Coordinate with Engineer.

D. Owner to provide all 120VAC power for control units. Coordinate location of power with owner's authorized representative.

E. Install electrical connections between central control unit components and satellite control units per manufacturer's recommendations.

F. Install electrical connections between satellite control units and monitoring equipment per manufacturer's recommendations.

G. Install all surge protection as per manufacturer's latest instructions.

H. Supplementary Grounding:

1. Provide and place grounding system for component(s) being protected.
2. Install all grounding circuit components in straight lines.
3. When necessary to make bends, do not make sharp turns.
4. Install all grounding equipment away from wires and cables.
5. Bond Supplementary Ground to the service ground using No. 6 AWG solid bare copper wire.
6. All splices shall be made using welding kit.
7. Drive one ground rod into the soil as specified. Secure wire to grounding rod assembly with welding kit.
8. Place grounding plate 30 inches deep with PowerSet earth contact material per manufacture's recommendations. Connect controller to grounding rod and plate as detailed with AWG No.6 solid conductor copper wire. Secure wire to plate assembly with welding kit.

I. Attach wire markers to the ends of control wires inside the controller unit housing. Label wires with an identification number that consists of the name and station number of the existing controller to which the control wire had been previously connected.

J. Connect control wires to corresponding control unit terminal, Connect wires to the satellite controller in the same order they were connected to the existing controller if applicable.

K. Coordinate location of wall mount controllers with building or electrical Contractor to facilitate electrical service and future maintenance needs. Wall mount shall be securely fastened to surface. If exterior mounted, wall mount controllers shall have electrical service wire and field control wire in separate, appropriate sized weatherproof electrical conduit, PVC pipe shall not be used.

L. Coordinate with OAR and Electrician to ensure that no conflicts exist with interference with high voltage electrical equipment in service area which would affect operation. Relocate if necessary.

M. Wire under hardscape surfaces shall be placed continuously in conduit.

N. Controllers shall be oriented such that Owner’s Representative maintenance personnel may access easily and perform field system tests efficiently.

O. Place Standard valve box at base of controller or nearby to allow for three to five feet of slack field control wire to be placed at each controller.

P. This Contractor shall provide conduit access if needed for Electrical contractor. Electrical supply and installation, as well as hook-up to controller shall be by this Contractor.

3.3 MASTER VALVE / FLOW SENSOR

A. Install master valves and flow sensors as per manufacturer's directions.

B. Master valve and flow sensor shall be installed in valve boxes per specification on detail sheet.

C. Underground wiring of FlowmecFlow Sensor products:

1. Cable: Flowmec sensors may be located up to 2000' from pulse transmitters or displays. All data communications while connecting flow sensors to the electronics that are buried below grade, with or without conduit, shall be constructed to direct burial specifications similar to Telecommunications Exchange Cable (REA PE-89).

2. The cable shall be constructed of 20 AWG, or larger, copper conductors twisted into pairs of varying lengths to prevent cross talk. Conductors shall be insulated with polyethylene or propylene with a suggested working voltage of 350 volts. The cable shall feature an aluminum-polyester shield and be finished with a black high-density polyethylene jacket Cable should be equivalent to AT&T PE- 39 or PE-89.

3. Splices: It is important that all wire connections be absolutely watertight with no leakage to ground or shorting from one conductor to another. AIl splices shall be 3M DBY/R-6 from Paige Wire.

4. Surge Protection for Sensors: Per Manufacturer’s recommendations.

D. All grounds to a 10-ohm or less earth ground.

E. Surge Arrestors shall be installed on the 2-wire communication path at each solitary satellite unit or the first satellite within a satellite cluster. The MSP-l Surge Arrestor shall be mounted in the stainless steel mounting bracket in the pedestal of the satellite unit or other suitable location. This surge arrestor shall be for the purpose of helping to prevent surges coming in on the 2-wire path and damaging the satellite.

3.4 ELECTRICAL CONTROL WIRES

A. Electrical control wires shall be installed in the same trench as the main line wherever possible. Wires shall be laid alongside the pipe by "snaking" into the trench to allow as much slack as possible for contraction and expansion of the wire. All wire connections at remote control valves and at all wire splices will be left with two feet of wire so that the splice or the valve manifold can be brought to the surface for repairs without disconnecting the wires.

3.5 It is important that the joint be absolutely waterproof so that there is no chance for leakage of water and corrosion build-up on the connection. All wiring shall be accomplished with as few splices as possible.

A. Splices in electric control wires shall be soldered first and then fitted with a 3M DBY Direct Bury Splice Kit. All splices shall be contained in a valve box, preferably in the same box as the electric remote control valves. Do not run short pieces of wire. Consult with the Engineer if any questions arise as to length or size of wire. Failure to do so will result in the replacement of the wire at the Contractors expense.

3.6 TRENCHES

A. Trenches shall be dug as deep and wide as necessary to properly place pipe. All sleeves are to be placed prior to laying of any hard surface. All trenches shall be backfilled and compacted to that of the surrounding material.

B. The Contractor, in placing the irrigation lines, etc. may uncover material not suitable for finished grading. This material shall be removed from the site. After the installation of the lines, the finished grading shall be smoothed over and restored to its original condition, using additional topsoil where necessary.

3.7 SLEEVE ASSEMBLY

A. The site may contain existing sleeves. Should conditions necessitate the rearrangement or placement of additional sleeves, the Contractor, before proceeding with the work, shall obtain approval from the Engineer before commencing work shown by the drawings.

B. Depth of sleeves to be determined by the type of line that is to be placed in sleeve. In the case of new construction, all sleeves are to be placed. Prior to laying of any hard surface. In the case of existing construction, the sleeves must be installed by boring under the existing hard surface.

C. PVC joints shall be glued according to manufacturer's recommendations.

D. Place pipe plug in each end of each unused sleeve pipe prior to backfilling.

E. Sleeves shall be extended 12” minimum beyond walk or edge of pavement.

F. Wire or cable shall not be installed in the same sleeve as piping but shall be installed in separate sleeves.

G. Sleeve ends on sleeve sizes 4” and larger shall be capped with corresponding sized PVC slip cap, pressure fit, until used, to prevent contamination.

H. Sleeve ends on sleeve sizes 3” and smaller may be thoroughly taped to prevent contamination.

I. Sleeves shall be installed at appropriate depths for main line pipe or lateral pipe

J. Contractor shall be responsible to protect existing underground utilities and components.

K. Sleeve all piping and wiring that pass under paving or hardscape features.

L. Sleeves shall be positioned relative to structures or obstructions to allow for pipe or wire within them to be removed if necessary.

3.8 PIPE ASSEMBLY

A. All ductile iron fittings having change of direction shall have proper concrete thrust block installed.

B. Over excavate trenches both in width and depth. Ensure base of trench is rock or debris free to protect pipe and wire. Grade trench base to ensure flat, even support of piping. Backfill with clean soil or import material.

C. Contractor shall backfill no less than 2” around entire pipe with clean, rock free fill.

D. Main line piping and fittings shall not be backfilled until Owner’s Representative has inspected and pipe has passed pressure testing. Perform balance of backfill operation to eliminate any settling.

E. Place irrigation pipe and other elements at uniform grades. Automatic drains shall not be installed on this Project. Manual drains shall only be installed at POC where designated on Construction Drawings.

F. Install pipe to allow for expansion and contraction as recommended by pipe manufacturer.

G. Contractor shall install piping to: minimize change of direction, avoid placement under large trees or large shrubs, avoid placement under hardscape features.

H. Plastic pipe shall be cut squarely. Burrs shall be removed, spigot ends of pipes 3" and larger shall be beveled.

I. Pipe shall not be glued unless ambient temperature is at least 50 degrees F. Pipe shall not be glued in rainy conditions unless properly tented.

J. All solvent weld joints shall be assembled using IPS 711 glue and P70 primer according to manufacturer's specification, no exceptions.

K. Glued main line pipe shall cure a minimum of 24 hours prior to being energized. Lateral lines shall cure a minimum of 2 hours prior to being energized and shall not remain under constant pressure unless cured for 24 hours.

L. All threaded joints shall be wrapped with Teflon tape or paste unless directed by product manufacturer or sealing by O-ring.

M. All main line pipe, lateral line pipe and other irrigation elements shall be bedded and backfilled with clean soil, free of rocks 1" and larger.

N. Contractor shall furnish and install additional backfill material as necessary due to rocky conditions.

O. Trenches and other elements shall be compacted and/or water settled to eliminate settling.

P. Debris from trenching operations un-usable for fill shall be removed from project and disposed of properly by Contractor.

Q. Maximum acceptable flow through piping shall be 5.0 FPS maximum flow through piping shall be:
   1. 1"—13 GPM
   2. 1-1/4"—22 GPM
   3. 1-1/2"—30 GPM
   4. 2"—50 GPM
   5. 2-1/2" 75 GPM
   6. 3"—110 GPM

R. Bedding material shall be placed a minimum of 6 inch in all directions around all mainline pipes prior to backfilling. Lateral line pipes shall have a minimum of 2 inch in all directions.

S. All mainlines, as shown on drawings, shall be installed to a depth of 18 inches minimum.

T. All lateral lines as shown on drawings shall be installed to a depth of 12 inches minimum.

U. Lines bordering curbs or sidewalks shall be 12 inches away to allow for maintenance and access to the lines.

V. All pipes shall be spaced with a minimum of 6” of separation horizontally from other pipes. Pipes shall not be placed above other pipes in a vertical condition.

W. Thrust Blocks: All solvent weld mainlines greater than 2 inches in size shall be installed with thrust blocks wherever a change of direction 45 degrees or greater occurs and as follows:

1. Bearing area of concrete thrust-block based on 200 PSI pressure and safe soil bearing load of 2,000 pounds per square foot.
2. Concrete blocking shall be cast in place and have a minimum of 114 square foot bearing against the fittings.
3. Block shall bear against fittings only and shall be clear of joints.
4. Contractor shall install block adequate to withstand full test pressure as well as to continuously withstand operation pressure under all conditions of service.

X. Joint Restraints: All bell and gasket joints shall have appropriate joint restraint systems.

1. Joint restraints on all fittings at directional changes in pipe and at all couplings within 50 feet of directional change.

Y. PVC joints shall be glued according to manufacturer's recommendations. Glued joints shall set for 24 hours before pressure is applied to lines. Before trenches are backfilled all lines shall be pressurized and checked for leaks.

3.9 FLUSHING AND TESTING

A. When the pipe lines are connected and the valves in place but before any drip tubing are installed, the control valves shall be opened and flushed with a full head of water to clean out the system. Main lines shall be tested before backfilling for a period of not less than one hour and shall have no leakage or loss of pressure.

B. Testing will be performed after. Completion of each circuit and after completion of the entire system. At this time any necessary repair work will be done at the Contractor's expense and the entire system will be in good working order prior to the issuance of the Certificate of Substantial Completion.

3.10 PIPING INSPECTIONS

A. Before any pipes are covered, the Engineer shall inspect the system for compliance with specifications and drawings. Any required changes will be made at this time at the expense of the Contractor.

3.11 SYSTEM OPERATION

A. The entire system will be tested in the presence of the Engineer and Property Owner's Authorized Representative, in order to ensure COMPLETE coverage of all areas to be watered and the automatic operation of the system using the central control system. If applicable, any changes required will be made at this time at the Contractor's expense.

3.12 VALVES AND ASSEMBLIES

A. Backflow Preventer: install using ductile iron spools and fittings for 2-1/2” and larger, brass fittings, unions and nipples for 2” and smaller. Encase backflow devices in aluminum enclosure, insulated.

3.13 QUICK COUPLER VALVE

A. Install one (1) quick coupler at point of connection, at the end of all mainline runs, and per plan and details.

B. Top of quick coupler valve cover shall allow for complete installation of valve box lid, but also allow for insertion and operation of key.

C. Base of quick coupler valve and top of quick coupler swing joint shall be encased in ¾”- gravel.

D. Contractor shall not place quick coupler valves further than 100 feet apart, to allow for spot watering or supplemental irrigation of new plant material.

E. Quick coupler valve at POC shall not be eliminated or relocated.

3.14 MANUAL CONTROL VALVE

A. For 3” and larger valves, place sleeve of 6” or larger pipe over top of valve vertically and then extend to grade. Place 10” round valve box over sleeve at grade. See detail for additional information.

B. Isolation valves 2-1/2” and smaller shall be contained in a Carson Standard size valve box. Valves shall be installed with S/80 PVC TOE Nipples one both sides of valve.

3.15 ELECTRIC REMOTE CONTROL VALVE

A. Contractor shall place remote control valves in groups as practical to economize on quantity of manifold isolation valves.

B. Remote control valves shall be located separately and individually in separate control boxes.
   1. Flows through 1" valves shall be 1-22 GPM.
   2. Flows through 1-1/2" valves shall be 23-50 GPM.
   3. Flows through 2" valves shall be 51 through 75 GPM

C. Valves shall be located in boxes with ample space surrounding them to allow access for maintenance and repair.

D. Where practical, group remote control valves in close proximity, and protect each grouping with a manifold isolation valve as shown in details. **Manifold Main Line (or Sub-Main Line) and all manifold components and isolation valves shall be at least as large as the largest diameter lateral served by the respective manifold**.

E. Valve boxes shall be set over valves so that all parts of the valve can be reached for service. Valve box and lid shall be set to be flush with finished grade.

F. Only one remote control valve may be installed in a Carson 1419124 box.

G. Place a minimum of 4" of ¾" washed gravel beneath valve box for drainage.

H. Bottom of remote control valve shall be a minimum of 2" above gravel.

I. See remote control valve manifold detail for more information.

J. Control valves shall be located in bark mulch areas. Avoid locating valves in areas of high pedestrian and vehicular circulation.

K. Each bank or section of control valves shall be enclosed in an adequate size valve box and extensions to allow the disassembly of valves contained within. Valve boxes shall be at finished grade with valve stems 4 inches below top of box and with 6 inch of clean gravel under the valve box. Isolation valves at all valve banks.

3.16 VALVE BOXES

A. Valve boxes shall be set flush with the finished grade. Valve manifolds shall be set 12 inch below the top of the box including ball valves and quick couplers where called for. Do NOT install more than two (2) electric remote control valves in a single valve box. All valves must have ample room and access for repair.

B. All valve boxes shall have valve number or identification branded in lid via headed steel or brass branding irons, minimum 2" tall.

1. Valves shall list Controller ID and station number (X00)
2. Wire splice boxes shall list (WS)
3. Stop & Waste shall list (S&W)
4. Ball Valves shall list (BV)
5. Quick couplers shall list (QC)
6. Master Valve shall list (MV)
7. Flow meter shall list (FM)

3.17 DRIP EMITTERS

A. Drip emitters shall be installed as detailed and as per manufacturer's recommendations.

B. Planting beds shall be graded to continuous uniform finish grade prior to emitter installation. Surface installed drip tubing shall be installed after plant material, but prior to bark mulch being installed. Any tubing visible at bark surface shall be re-installed at Contractor expense.

C. Contractor shall place filters, regulators, air/vac vents and flush valves as necessary to meet manufacturer’s minimum recommendations.

D. Field conditions, specifically soil type conditions shall dictate any alteration in emitter size and emitter spacing. Contractor shall notify OAR to request confirmation of soil type prior to ordering drip tubing products to ensure proper product and proper spacing are used.

3.18 INSPECTION

A. At the time of final inspection the entire system must then be tested in the presence of the Engineer. It must operate in a satisfactory manner, with a full coverage of the areas indicated on the plans.

B. Before the final inspection is complete; the Contractor must furnish "as-built" drawings. These drawings should be updated on a daily basis to assure accuracy. The drawings must show the location of all valves, pipe, heads, controller control lines, and drain valves used on the job. These drawings and maintenance manuals must be submitted at the time of final inspection or in accordance to the general conditions. Measurement for equipment shall be triangulated from two fixed points within the project hardscape.

C. Test and demonstrate to the Engineer the satisfactory operation of the system free of leaks. Instruct the owner's designated personnel in the operation of the system pursuant to the training section already outlined in the specifications.

D. A minimum of 30 hours of training for up to 2 user personnel shall be conducted by the Distributor's training personnel at a place and time to be determined. The Contractor is to

schedule, coordinate, and attend the training session. Training shall include an overview of system operations as well as detailed one-on-one training for selected individuals for both software and hardware operation.

3.19 ADJUSTMENT AND CLEAN-UP

A. After completion of grading, planting, and mulching carefully adjust irrigation system as required.

B. Sprinkler heads shall be adjusted to proper height when installed.

C. Changes in grade or adjustment of head height after installation shall be considered a part of the original contract and at Contractor's expense.

D. Adjust all sprinkler heads for arc, radius, proper trim and distribution to cover all landscaped areas that are to be irrigated. Adjust sprinklers so they do not water buildings, structures, or other hardscape features.

E. Adjust run times of stations to meet the needs of plant material the station services.

F. No sprinkler shall be located closer than 6" to walls, fences, or buildings.

G. Heads adjacent to walks, curbs, or paths shall be located at grade and 2" away from hardscape.

H. Control valves shall be opened and fully flush lateral line pipe and swing joints prior to installation of sprinklers.

I. Spray heads shall be installed and flushed again prior to installation of nozzles.

J. Contractor shall be responsible for adjustment if necessary due to grade changes during landscape construction.

K. Contractor shall clean all work areas daily, leaving areas accessible to the public in a 'broom clean' condition.

L. Open trenches and or hazards shall be protected by chain link fence, snow fencing, or caution tape as directed by the OAR.

M. Contractor shall coordinate with OAR for periodic as well as final cleanliness inspection.

N. Upon project completion, Contractor shall remove all excess material, construction debris, packing, etc. attributable to his work.

O. Completed project shall be left in a ‘broom clean’ condition.

SECTION 329115 - SOIL PREPARATION (PERFORMANCE SPECIFICATION)

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 planting soils specified according to performance requirements of the mixes.

1.3 DEFINITIONS

A. AAPFCO: Association of American Plant Food Control Officials.

B. Backfill: The earth used to replace or the act of replacing earth in an excavation. This can be amended or unamended soil as indicated.

C. CEC: Cation exchange capacity.

D. Compost: The product resulting from the controlled biological decomposition of organic material that has been sanitized through the generation of heat and stabilized to the point that it is beneficial to plant growth.

E. Duff Layer: A surface layer of soil, typical of forested areas, that is composed of mostly decayed leaves, twigs, and detritus.

F. Imported Soil: Soil that is transported to Project site for use.

G. Layered Soil Assembly: A designed series of planting soils, layered on each other, that together produce an environment for plant growth.

H. Manufactured Soil: Soil produced by blending soils, sand, stabilized organic soil amendments, and other materials to produce planting soil.

I. NAPT: North American Proficiency Testing Program. An SSSA program to assist soil-, plant-, and water-testing laboratories through interlaboratory sample exchanges and statistical evaluation of analytical data.

J. Organic Matter: The total of organic materials in soil exclusive of undecayed plant and animal tissues, their partial decomposition products, and the soil biomass; also called "humus" or "soil organic matter."

K. Planting Soil: Existing, on-site soil; imported soil; or manufactured soil that has been modified as specified with soil amendments and perhaps fertilizers to produce a soil mixture best for plant growth.

L. RCRA Metals: Hazardous metals identified by the EPA under the Resource Conservation and Recovery Act.

M. SSSA: Soil Science Society of America.

N. Subgrade: Surface or elevation of subsoil remaining after excavation is complete, or the top surface of a fill or backfill before planting soil is placed.

O. Subsoil: Soil beneath the level of subgrade; soil beneath the topsoil layers of a naturally occurring soil profile, typified by less than 1 percent organic matter and few soil organisms.

P. Surface Soil: Soil that is present at the top layer of the existing soil profile. In undisturbed areas, surface soil is typically called "topsoil"; but in disturbed areas such as urban environments, the surface soil can be subsoil.

Q. USCC: U.S. Composting Council.

1.4 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1.5 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Include recommendations for application and use.
2. Include test data substantiating that products comply with requirements.
3. Include sieve analyses for aggregate materials.
4. Material Certificates: For each type of imported soil and soil amendment and fertilizer before delivery to the site, according to the following:

    a. Manufacturer's qualified testing agency's certified analysis of standard products.
    b. Analysis of fertilizers, by a qualified testing agency, made according to AAPFCO methods for testing and labeling and according to AAPFCO's SUIP #25.
    c. Analysis of nonstandard materials, by a qualified testing agency, made according to SSSA methods, where applicable.

B. Samples: For each bulk-supplied material, 1-quart volume of each in sealed containers labeled with content, source, and date obtained. Each Sample shall be typical of the lot of material to be furnished; provide an accurate representation of composition, color, and texture.

1.6 INFORMATIONAL SUBMITTALS

A. Qualification Data: For each testing agency.

B. Preconstruction Test Reports: For preconstruction soil analyses specified in "Preconstruction Testing" Article.

C. Field quality-control reports.

1.7 QUALITY ASSURANCE

A. Testing Agency Qualifications: An independent, state-operated, or university-operated laboratory; experienced in soil science, soil testing, and plant nutrition; with the experience and capability to conduct the testing indicated; and that specializes in types of tests to be performed.

1. Laboratories: Subject to compliance with requirements, provide testing by the following:

a. Soil Testing Laboratory at Utah State University.

1.8 PRECONSTRUCTION TESTING

A. Preconstruction Testing Service: Engage a qualified testing agency to perform preconstruction soil analyses on existing, on-site soil.

1. Notify Architect and Landscape Architect seven days in advance of the dates and times when and indicate locations where laboratory samples will be taken.

B. Preconstruction Soil Analyses: For each unamended soil type, perform testing on soil samples and furnish soil analysis and a written report containing soil-amendment and fertilizer recommendations by a qualified testing agency performing the testing according to "Soil-Sampling Requirements" and "Testing Requirements" articles.

1. Have testing agency identify and label samples and test reports according to sample collection and labeling requirements.

1.9 SOIL-SAMPLING REQUIREMENTS

A. General: Extract soil samples according to requirements in this article.

B. Sample Collection and Labeling: Have samples taken and labeled by state-certified, -licensed, or -registered soil scientist under the direction of the testing agency.

1. Number and Location of Samples: Minimum of eight representative soil samples from varied locations for each soil to be used or amended for landscaping purposes.
2. Procedures and Depth of Samples: According to USDA-NRCS's "Field Book for Describing and Sampling Soils."
3. Division of Samples: Split each sample into two, equal parts. Send half to the testing agency and half to Owner for its records.

4. Labeling: Label each sample with the date, location keyed to a site plan or other location system, visible soil condition, and sampling depth.

1.10 TESTING REQUIREMENTS

A. General: Perform tests on soil samples according to requirements in this article.

B. Physical Testing:

1. Soil Texture: Soil-particle, size-distribution analysis by one of the following methods according to SSSA's "Methods of Soil Analysis - Part 1-Physical and Mineralogical Methods":

   a. Sieving Method: Report sand-gradation percentages for very coarse, coarse, medium, fine, and very fine sand; and fragment-gradation (gravel) percentages for fine, medium, and coarse fragments; according to USDA sand and fragment sizes.
   b. Hydrometer Method: Report percentages of sand, silt, and clay.

2. Bulk Density: Analysis according to core method and clod method of SSSA's "Methods of Soil Analysis - Part 1-Physical and Mineralogical Methods."
3. Total Porosity: Calculate using particle density and bulk density according to SSSA's "Methods of Soil Analysis - Part 1-Physical and Mineralogical Methods."
4. Water Retention: According to SSSA's "Methods of Soil Analysis - Part 1-Physical and Mineralogical Methods."
5. Saturated Hydraulic Conductivity: According to SSSA's "Methods of Soil Analysis - Part 1-Physical and Mineralogical Methods"; at 85% compaction according to ASTM D 698 (Standard Proctor).

C. Chemical Testing:

1. CEC: Analysis by sodium saturation at pH 7 according to SSSA's "Methods of Soil Analysis - Part 3- Chemical Methods."
2. Clay Mineralogy: Analysis and estimated percentage of expandable clay minerals using CEC by ammonium saturation at pH 7 according to SSSA's "Methods of Soil Analysis - Part 1-Physical and Mineralogical Methods."
3. Metals Hazardous to Human Health: Test for presence and quantities of RCRA metals including aluminum, arsenic, barium, copper, cadmium, chromium, cobalt, lead, lithium, and vanadium. If RCRA metals are present, include recommendations for corrective action.
4. Phytotoxicity: Test for plant-available concentrations of phytotoxic minerals including aluminum, arsenic, barium, cadmium, chlorides, chromium, cobalt, copper, lead, lithium, mercury, nickel, selenium, silver, sodium, strontium, tin, titanium, vanadium, and zinc. Include oils, herbicides and pesticides.

D. Fertility Testing: Soil fertility analysis according to standard laboratory protocol of SSSA NAPT WERA-103, including the following:

1. Percentage of organic matter.
2. CEC, calcium percent of CEC, and magnesium percent of CEC.

3. Soil reaction (acidity/alkalinity pH value).
4. Buffered acidity or alkalinity.
5. Nitrogen ppm.
6. Phosphorous ppm.
7. Potassium ppm.
8. Manganese ppm.
9. Manganese-availability ppm.
10. Zinc ppm.
11. Zinc availability ppm.
12. Copper ppm.
13. Sodium ppm and sodium absorption ratio.
14. Soluble-salts ppm.
15. Presence and quantities of problem materials including salts and metals cited in the Standard protocol. If such problem materials are present, provide additional recommendations for corrective action.
16. Other deleterious materials, including their characteristics and content of each.

E. Organic-Matter Content: Analysis using loss-by-ignition method according to SSSA's "Methods of Soil Analysis - Part 3-Chemical Methods."

F. Recommendations: Based on the test results, state recommendations for soil treatments and soil amendments to be incorporated to produce satisfactory planting soil suitable for healthy, viable plants indicated. Include, at a minimum, recommendations for nitrogen, phosphorous, and potassium fertilization, and for micronutrients.

1. Fertilizers and Soil Amendment Rates: State recommendations in weight per 1000 sq. ft. for 6-inchdepth of soil.
2. Soil Reaction: State the recommended liming rates for raising pH or sulfur for lowering pH according to the buffered acidity or buffered alkalinity in weight per 1000 sq. ft. for 6-inchdepth of soil.

1.11 DELIVERY, STORAGE, AND HANDLING

A. Packaged Materials: Deliver packaged materials in original, unopened containers showing weight, certified analysis, name and address of manufacturer, and compliance with state and Federal laws if applicable.

B. Bulk Materials:

1. Do not dump or store bulk materials near structures, utilities, walkways and pavements, or on existing turf areas or plants.
2. Provide erosion-control measures to prevent erosion or displacement of bulk materials, discharge of soil-bearing water runoff, and airborne dust reaching adjacent properties, water conveyance systems, or walkways.
3. Do not move or handle materials when they are wet or frozen.
4. Accompany each delivery of bulk fertilizers and soil amendments with appropriate certificates.

PART 2 - PRODUCTS

2.1 PLANTING SOILS SPECIFIED ACCORDING TO PERFORMANCE REQUIREMENTS

A. Planting-Soil Type: Existing, on-site surface soil, with the duff layer, if any, retained; and stockpiled on-site; modified to produce viable planting soil. Using preconstruction soil analyses and materials specified in other articles of this Section, amend existing, on-site surface soil to become planting soil complying with the following requirements:

1. Percentage of Organic Matter: Minimum 6 percent by volume.
2. Soil Reaction: pH of 6.5 to 7.3.
3. CEC of Total Soil: Minimum 10 meq/100 mL at pH of 7.0.
4. CEC of Clay Fraction: Maximum 15 meq/100 mL at pH of 7.0.
5. Soluble-Salt Content: 5 to 10 dS/m measured by electrical conductivity.
6. Bulk Density: 1.2 g/cu. cm to 1.4 g/cu. cm at 85% compaction.
7. Total Porosity: Minimum 50 percent at 85% compaction.
8. Macro Porosity: Minimum 5 percent at 85% compaction.
9. RCRA Metals: Below maximum limits established by the EPA.
10. Phytotoxicity: Below phytotoxicity limits established by SSSA.

B. Planting-Soil Type: Imported, naturally formed soil from off-site sources and consisting of silt loam soil according to USDA textures; and modified to produce viable planting soil. Amend imported soil with materials specified in other articles of this Section to become planting soil complying with the following requirements:

1. Sources: Take imported, unamended soil from sources that are naturally well-drained sites where topsoil occurs at least 4 inches deep, not from agricultural land, bogs, or marshes; and that do not contain undesirable organisms; disease-causing plant pathogens; or obnoxious weeds and invasive plants including, but not limited to, quackgrass, Johnsongrass, poison ivy, nutsedge, nimblewill, Canada thistle, bindweed, bentgrass, wild garlic, ground ivy, perennial sorrel, and bromegrass.
2. Additional Properties of Imported Soil before Amending: Minimum of 6 percent organic-matter content, friable, and with sufficient structure to give good tilth and aeration. Clean soil to be of the following:

    a. Unacceptable Materials: Concrete slurry, concrete layers or chunks, cement, plaster, building debris, oils, gasoline, diesel fuel, paint thinner, turpentine, tar, roofing compound, acid, and other extraneous materials that are harmful to plant growth.
    b. Unsuitable Materials: Stones, roots, plants, sod, clay lumps, and pockets of coarse sand that exceed a combined maximum of 8 percent by dry weight of the imported soil.
    c. Large Materials: Stones, clods, roots, clay lumps, and pockets of coarse sand exceeding 2 inches in any dimension.

3. Percentage of Organic Matter: Minimum 6 percent by volume.
4. Soil Reaction: pH of 6.5 to 7.3.
5. CEC of Total Soil: Minimum 10 meq/100 mL at pH of 7.0.
6. CEC of Clay Fraction: Maximum 15 meq/100 mL at pH of 7.0.

7. Soluble-Salt Content: 5 to 10 dS/m measured by electrical conductivity.
8. Bulk Density: 1.2 g/cu. cm to 1.4 g/cu. cm at 85% compaction.
9. Total Porosity: Minimum 50 percent at 85% compaction.
10. Macro Porosity: Minimum 5 percent at 85% compaction.
11. RCRA Metals: Below maximum limits established by the EPA.
12. Phytotoxicity: Below phytotoxicity limits established by SSSA.

2.2 INORGANIC SOIL AMENDMENTS (As recommended or required in Testing Reports)

A. Lime: ASTM C 602, agricultural liming material containing a minimum of 80 percent calcium carbonate equivalent and as follows:

1. Class: T, with a minimum of 99 percent passing through a No. 8 sieve and a minimum of 75 percent passing through a No. 60 sieve.
2. Class: O, with a minimum of 95 percent passing through No. 8 sieve and a minimum of 55 percent passing through a No. 60 sieve.
3. Form: Provide lime in form of ground dolomitic limestone.

B. Sulfur: Granular, biodegradable, and containing a minimum of 90 percent elemental sulfur, with a minimum of 99 percent passing through a No. 6 sieve and a maximum of 10 percent passing through a No. 40 sieve.

C. Iron Sulfate: Granulated ferrous sulfate containing a minimum of 20 percent iron and 10 percent sulfur.

D. Agricultural Gypsum: Minimum 90 percent calcium sulfate, finely ground with 90 percent passing through a No. 50 sieve.

E. Sand: Clean, washed, natural or manufactured, free of toxic materials, and according to ASTM C 33/C 33M.

2.3 ORGANIC SOIL AMENDMENTS (As recommended or required in Testing Reports)

A. Compost: Well-composted, stable, and weed-free organic matter produced by composting feedstock, and bearing USCC's "Seal of Testing Assurance," and as follows:

1. Feedstock: Limited to leaves.
2. Reaction: pH of 5.5 to 7.5.
3. Soluble-Salt Concentration: Less than 4 dS/m.
4. Moisture Content: 35 to 55 percent by weight.
5. Organic-Matter Content: 30 to 40 percent of dry weight.
6. Particle Size: Minimum of 98 percent passing through a 2-inch sieve.

B. Sphagnum Peat: Partially decomposed sphagnum peat moss, finely divided or of granular texture with 100 percent passing through a 1/2-inch sieve, a pH of 3.4 to 4.8, and a soluble-salt content measured by electrical conductivity of maximum 5 dS/m.

C. Muck Peat: Partially decomposed moss peat, native peat, or reed-sedge peat, finely divided or of granular texture with 100 percent passing through a 1/2-inch sieve, a pH of 6 to 7.5, a soluble-salt content measured by electrical conductivity of maximum 5 dS/m, having a water-absorbing capacity of 1100 to 2000 percent, and containing no sand.

D. Wood Derivatives: Shredded and composted, nitrogen-treated sawdust, ground bark, or wood waste; of uniform texture and free of chips, stones, sticks, soil, or toxic materials.

1. Partially Decomposed Wood Derivatives: In lieu of shredded and composted wood derivatives, mix shredded and partially decomposed wood derivatives with ammonium nitrate at a minimum rate of 0.15 lb/cu. ft. of loose sawdust or ground bark, or with ammonium sulfate at a minimum rate of 0.25 lb/cu. ft. of loose sawdust or ground bark.

E. Manure: Well-rotted, unleached, stable or cattle manure containing not more than 25 percent by volume of straw, sawdust, or other bedding materials; free of toxic substances, stones, sticks, soil, weed seed, debris, and material harmful to plant growth. Sterilized.

2.4 FERTILIZERS (As recommended or required in Testing Reports)

A. Superphosphate: Commercial, phosphate mixture, soluble; a minimum of 20 percent available phosphoric acid.

B. Commercial Fertilizer: Commercial-grade complete fertilizer of neutral character, consisting of fast- and slow-release nitrogen, 50 percent derived from natural organic sources of urea formaldehyde, phosphorous, and potassium in the following composition:

1. Composition: 1 lb/1000 sq. ft. of actual nitrogen, 4 percent phosphorous, and 2 percent potassium, by weight.
2. Composition: Nitrogen, phosphorous, and potassium in amounts recommended in soil reports from a qualified testing agency.

C. Slow-Release Fertilizer: Granular or pelleted fertilizer consisting of 50 percent water-insoluble nitrogen, phosphorus, and potassium in the following composition:

1. Composition: 20 percent nitrogen, 10 percent phosphorous, and 10 percent potassium, by weight.
2. Composition: Nitrogen, phosphorous, and potassium in amounts recommended in soil reports from a qualified testing agency.

D. Chelated Iron: Commercial-grade FeEDDHA for dicots and woody plants, and commercial-grade FeDTPA for ornamental grasses and monocots.

PART 3 - EXECUTION

3.1 GENERAL

A. Place planting soil and fertilizers according to requirements in other Specification Sections.

B. Verify that no foreign or deleterious material or liquid such as paint, paint washout, concrete slurry, concrete layers or chunks, cement, plaster, oils, gasoline, diesel fuel, paint thinner, turpentine, tar, roofing compound, or acid has been deposited in planting soil.

C. Proceed with placement only after unsatisfactory conditions have been corrected.

D. Notify Architect and Landscape Architect 7 days minimum prior to beginning work.

3.2 PREPARATION OF UNAMENDED, ON-SITE SOIL BEFORE AMENDING

A. Excavation: Excavate soil from designated area(s) to a depth of 6 inches and stockpile until amended.

B. Unacceptable Materials: Clean soil of concrete slurry, concrete layers or chunks, cement, plaster, building debris, oils, gasoline, diesel fuel, paint thinner, turpentine, tar, roofing compound, acid, and other extraneous materials that are harmful to plant growth.

C. Unsuitable Materials: Clean soil to contain a combined maximum of 8 percent by dry weight of stones, roots, plants, sod, clay lumps, and pockets of coarse sand.

D. Screening: Pass unamended soil through a 2-inch sieve to remove large materials.

3.3 PLACING AND MIXING PLANTING SOIL OVER EXPOSED SUBGRADE

A. General: Apply and mix unamended soil with amendments on-site to produce required planting soil. Do not apply materials or till if existing soil or subgrade is frozen, muddy, or excessively wet.

B. Subgrade Preparation: Till subgrade to a minimum depth of 12 inches. Remove stones larger than 2 inches in any dimension and sticks, roots, rubbish, and other extraneous matter and legally dispose of them off Owner's property.

1. Apply, add soil amendments, and mix approximately half the thickness of unamended soil over prepared, loosened subgrade according to "Mixing" Paragraph below. Mix thoroughly into top 4 inches of subgrade. Spread remainder of planting soil.

C. Mixing: Spread unamended soil to total depth of 12 inches, but not less than required to meet finish grades after mixing with amendments and natural settlement. Do not spread if soil or subgrade is frozen, muddy, or excessively wet.

1. Amendments: Apply soil amendments and fertilizer, if required, evenly on surface, and thoroughly blend them with unamended soil to produce planting soil.

a. Mix lime or sulfur with dry soil before mixing fertilizer.
b. Mix fertilizer with planting soil no more than seven days before planting.

2. Lifts: Apply and mix unamended soil and amendments in lifts not exceeding 8 inches in loose depth for material compacted by compaction equipment, and not more than 4 inches in loose depth for material compacted by hand-operated tampers.

D. Compaction: Compact each blended lift of planting soil to 75 to 82 percent of maximum Standard Proctor density according to ASTM D 698.

E. Finish Grading: Grade planting soil to a smooth, uniform surface plane with loose, uniformly fine texture. Roll and rake, remove ridges, and fill depressions to meet finish grades.

3.4 BLENDING PLANTING SOIL IN PLACE

A. General: Mix amendments with in-place, unamended soil to produce required planting soil. Do not apply materials or till if existing soil or subgrade is frozen, muddy, or excessively wet.

B. Preparation: Till unamended, existing soil in planting areas to a minimum depth of 12 inches. Remove stones larger than 2 inches in any dimension and sticks, roots, rubbish, and other extraneous matter and legally dispose of them off Owner's property.

C. Mixing: Apply soil amendments and fertilizer, if required, evenly on surface, and thoroughly blend them into full depth of unamended, in-place soil to produce planting soil.

1. Mix lime or sulfur with dry soil before mixing fertilizer.
2. Mix fertilizer with planting soil no more than seven days before planting.

D. Compaction: Compact blended planting soil to 75 to 82 percent of maximum Standard Proctor density according to ASTM D 698.

E. Finish Grading: Grade planting soil to a smooth, uniform surface plane with loose, uniformly fine texture. Roll and rake, remove ridges, and fill depressions to meet finish grades.

3.5 APPLYING COMPOST TO SURFACE OF PLANTING SOIL

A. Application: Apply 4 inches of the compost component of planting-soil mix to surface of in-place planting soil. Do not apply materials or till if existing soil or subgrade is frozen, muddy, or excessively wet.

B. Finish Grading: Grade surface to a smooth, uniform surface plane with loose, uniformly fine texture. Roll and rake, remove ridges, and fill depressions to meet finish grades.

3.6 FIELD QUALITY CONTROL

A. Testing Agency: Engage a qualified testing agency to perform tests and inspections.

B. Perform the following tests and inspections:

1. Compaction: Test planting-soil compaction after placing each lift and at completion using a densitometer or soil-compaction meter calibrated to a reference test value based on

laboratory testing according to ASTM D 698. Space tests at no less than one for each 2000 sq. ft. of in-place soil or part thereof.

2. Performance Testing: For each amended planting-soil type, demonstrating compliance with specified performance requirements. Perform testing according to "Soil-Sampling Requirements" and "Testing Requirements" articles.

C. Soil will be considered defective if it does not pass tests and inspections.

D. Prepare test and inspection reports.

E. Label each sample and test report with the date, location keyed to a site plan or other location system, visible conditions when and where sample was taken, and sampling depth.

3.7 PROTECTION

A. Protection Zone: Identify protection zones according to Section 015639 "Temporary Tree and Plant Protection."

B. Protect areas of in-place soil from additional compaction, disturbance, and contamination. Prohibit the following practices within these areas except as required to perform planting operations:

1. Storage of construction materials, debris, or excavated material.
2. Parking vehicles or equipment.
3. Vehicle traffic.
4. Foot traffic.
5. Erection of sheds or structures.
6. Impoundment of water.
7. Excavation or other digging unless otherwise indicated.

C. If planting soil or subgrade is overcompacted, disturbed, or contaminated by foreign or deleterious materials or liquids, remove the planting soil and contamination; restore the subgrade as directed by Architect and Landscape Architect and replace contaminated planting soil with new planting soil.

3.8 CLEANING

A. Protect areas adjacent to planting-soil preparation and placement areas from contamination. Keep adjacent paving and construction clean and work area in an orderly condition.

B. Remove surplus soil and waste material including excess subsoil, unsuitable materials, trash, and debris and legally dispose of them off Owner's property unless otherwise indicated.

1. Dispose of excess subsoil and unsuitable materials on-site where directed by Owner.

END OF SECTION 329115

SECTION 32 9200 - TURF AND GRASSES

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Sodding.

B. Related Requirements:

1. Section 32 9300 "Plants" for trees, shrubs, ground covers, and other plants as well as border edgings and mow strips.

1.2 DEFINITIONS

A. Finish Grade: Elevation of finished surface of planting soil.

B. Pesticide: A substance or mixture intended for preventing, destroying, repelling, or mitigating a pest. Pesticides include insecticides, miticides, herbicides, fungicides, rodenticides, and molluscicides. They also include substances or mixtures intended for use as a plant regulator, defoliant, or desiccant.

C. Pests: Living organisms that occur where they are not desired or that cause damage to plants, animals, or people. Pests include insects, mites, grubs, mollusks (snails and slugs), rodents (gophers, moles, and mice), unwanted plants (weeds), fungi, bacteria, and viruses.

D. Planting Soil: Existing, on-site soil; imported soil; or manufactured soil that has been modified with soil amendments and perhaps fertilizers to produce a soil mixture best for plant growth. See Section 32 9115 "Soil Preparation (Performance Specification)" and drawing designations for planting soils.

E. Subgrade: The surface or elevation of subsoil remaining after excavation is complete, or the top surface of a fill or backfill before planting soil is placed.

1.3 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1.4 INFORMATIONAL SUBMITTALS

A. Qualification Data: For landscape Installer.

B. Certification of Grass Seed: From seed vendor for each grass-seed monostand or mixture, stating the botanical and common name, percentage by weight of each species and variety, and percentage of purity, germination, and weed seed. Include the year of production and date of packaging.

1. Certification of each seed mixture for turfgrass sod. Include identification of source and name and telephone number of supplier.

C. Product Certificates: For fertilizers, from manufacturer.

D. Pesticides and Herbicides: Product label and manufacturer's application instructions specific to Project.

1.5 CLOSEOUT SUBMITTALS

A. Maintenance Data: Recommended procedures to be established by Owner for maintenance of turf during a calendar year. Submit before expiration of required maintenance periods.

1.6 QUALITY ASSURANCE

A. Installer Qualifications: A qualified landscape installer whose work has resulted in successful turf establishment.

1. Professional Membership: Installer shall be a member in good standing of either the National Association of Landscape Professionals or AmericanHort.
2. Experience: Five years' experience in turf installation in addition to requirements in Section 01 4000 "Quality Requirements."
3. Installer's Field Supervision: Require Installer to maintain an experienced full-time supervisor on Project site when work is in progress.
4. Personnel Certifications: Installer's field supervisor shall have certification in one of the following categories from the National Association of Landscape Professionals:

    a. Landscape Industry Certified Technician - Exterior.
    b. Landscape Industry Certified Lawn Care Manager.
    c. Landscape Industry Certified Lawn Care Technician.

5. Pesticide Applicator: State licensed, commercial.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Seed and Other Packaged Materials: Deliver packaged materials in original, unopened containers showing weight, certified analysis, name and address of manufacturer, and indication of compliance with state and Federal laws, as applicable.

B. Sod: Harvest, deliver, store, and handle sod according to requirements in "Specifications for Turfgrass Sod Materials" and "Specifications for Turfgrass Sod Transplanting and Installation"

sections in TPI's "Guideline Specifications to Turfgrass Sodding." Deliver sod within 24 hours of harvesting and in time for planting promptly. Protect sod from breakage and drying.

C. Bulk Materials:

1. Do not dump or store bulk materials near structures, utilities, walkways and pavements, or on existing turf areas or plants.
2. Provide erosion-control measures to prevent erosion or displacement of bulk materials; discharge of soil-bearing water runoff; and airborne dust reaching adjacent properties, water conveyance systems, or walkways.
3. Accompany each delivery of bulk materials with appropriate certificates.

1.8 FIELD CONDITIONS

A. Planting Restrictions: Plant during one of the following periods. Coordinate planting periods with initial maintenance periods to provide required maintenance from date of Substantial Completion.

1. Spring Planting: April 15-June 15.
2. Fall Planting: August 15-October 15.

B. Weather Limitations: Proceed with planting only when existing and forecasted weather conditions permit planting to be performed when beneficial and optimum results may be obtained. Apply products during favorable weather conditions according to manufacturer's written instructions.

PART 2 - PRODUCTS

2.1 TURFGRASS SOD

A. Sod: Proprietary as follows:

1. Products: Subject to compliance with requirements, provide the following:

a. Imperial Blue Sod via Chanshare Sod Farms Inc. 10785 W. 12800 N Tremonton, Utah 84337, 435-854-3627, info@biograss.net

2.2 FERTILIZERS

A. Commercial Fertilizer: Commercial-grade complete fertilizer of neutral character, consisting of fast- and slow-release nitrogen, 50 percent derived from natural organic sources of urea formaldehyde, phosphorous, and potassium in the following composition:

1. Composition:

a. 1 lb/1000 sq. ft. of actual nitrogen, 4 percent phosphorous, and 2 percent potassium, by weight.

b. Nitrogen, phosphorous, and potassium in amounts recommended in soil reports from a qualified soil-testing laboratory.

B. Slow-Release Fertilizer: Granular or pelleted fertilizer consisting of 50 percent water-insoluble nitrogen, phosphorus, and potassium in the following composition:

1. Composition:

a. 20 percent nitrogen, 10 percent phosphorous, and 10 percent potassium, by weight.
b. Nitrogen, phosphorous, and potassium in amounts recommended in soil reports from a qualified soil-testing laboratory.

2.3 PESTICIDES

A. General: Pesticide, registered and approved by the EPA, acceptable to authorities having jurisdiction, and of type recommended by manufacturer for each specific problem and as required for Project conditions and application. Do not use restricted pesticides unless authorized in writing by authorities having jurisdiction.

B. Pre-Emergent Herbicide (Selective and Nonselective): Effective for controlling the germination or growth of weeds within planted areas at the soil level directly below the mulch layer.

C. Post-Emergent Herbicide (Selective and Nonselective): Effective for controlling weed growth that has already germinated.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas to be planted for compliance with requirements and other conditions affecting installation and performance of the Work.

1. Verify that no foreign or deleterious material or liquid such as paint, paint washout, concrete slurry, concrete layers or chunks, cement, plaster, oils, gasoline, diesel fuel, paint thinner, turpentine, tar, roofing compound, or acid has been deposited in soil within a planting area.
2. Suspend planting operations during periods of excessive soil moisture until the moisture content reaches acceptable levels to attain the required results.
3. Uniformly moisten excessively dry soil that is not workable or which is dusty.

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

C. If contamination by foreign or deleterious material or liquid is present in soil within a planting area, remove the soil and contamination as directed by Architect and replace with new planting soil.

3.2 PREPARATION

A. Protect structures; utilities; sidewalks; pavements; and other facilities, trees, shrubs, and plantings from damage caused by planting operations.

1. Protect adjacent and adjoining areas from hydroseeding and hydromulching overspray.
2. Protect grade stakes set by others until directed to remove them.

B. Install erosion-control measures to prevent erosion or displacement of soils and discharge of soil-bearing water runoff or airborne dust to adjacent properties and walkways.

3.3 TURF AREA PREPARATION

A. General: Prepare planting area for soil placement and mix planting soil according to Section 32 9115 "Soil Preparation (Performance Specification)."

B. Placing Planting Soil: Place and mix planting soil in place over exposed subgrade.

1. Reduce elevation of planting soil to allow for soil thickness of sod.

C. Moisten prepared area before planting if soil is dry. Water thoroughly and allow surface to dry before planting. Do not create muddy soil.

D. Before planting, obtain Architect's acceptance of finish grading; restore planting areas if eroded or otherwise disturbed after finish grading.

3.4 SODDING

A. Lay sod within 24 hours of harvesting. Do not lay sod if dormant or if ground is frozen or muddy.

B. Lay sod to form a solid mass with tightly fitted joints. Butt ends and sides of sod; do not stretch or overlap. Stagger sod strips or pads to offset joints in adjacent courses. Avoid damage to soil or sod during installation. Tamp and roll lightly to ensure contact with soil, eliminate air pockets, and form a smooth surface. Work sifted soil or fine sand into minor cracks between pieces of sod; remove excess to avoid smothering sod and adjacent grass.

1. Lay sod across slopes exceeding 1:3.
2. Anchor sod on slopes exceeding 1:6 with wood pegs spaced as recommended by sod manufacturer but not less than two anchors per sod strip to prevent slippage.

C. Saturate sod with fine water spray within two hours of planting. During first week after planting, water daily or more frequently as necessary to maintain moist soil to a minimum depth of 1-1/2 inches below sod.

3.5 TURF MAINTENANCE

A. General: Maintain and establish turf by watering, fertilizing, weeding, mowing, trimming, replanting, and performing other operations as required to establish healthy, viable turf. Roll, regrade, and replant bare or eroded areas and remulch to produce a uniformly smooth turf. Provide materials and installation the same as those used in the original installation.

1. Fill in as necessary soil subsidence that may occur because of settling or other processes. Replace materials and turf damaged or lost in areas of subsidence.
2. In areas where mulch has been disturbed by wind or maintenance operations, add new mulch and anchor as required to prevent displacement.
3. Apply treatments as required to keep turf and soil free of pests and pathogens or disease. Use integrated pest management practices whenever possible to minimize the use of pesticides and reduce hazards.

B. Watering: Install and maintain temporary piping, hoses, and turf-watering equipment to convey water from sources and to keep turf uniformly moist to a depth of 4 inches.

1. Schedule watering to prevent wilting, puddling, erosion, and displacement of seed or mulch. Lay out temporary watering system to avoid walking over muddy or newly planted areas.
2. Water turf with fine spray at a minimum rate of 1 inch per week unless rainfall precipitation is adequate.

C. Turf Postfertilization: Apply commercial fertilizer after initial mowing and when grass is dry.

1. Use fertilizer that provides actual nitrogen of at least 1 lb/1000 sq. ft. to turf area.

3.6 SATISFACTORY TURF

A. Turf installations shall meet the following criteria as determined by Architect:

1. Satisfactory Sodded Turf: At end of maintenance period, a healthy, well-rooted, even-colored, viable turf has been established, free of weeds, open joints, bare areas, and surface irregularities.

B. Use specified materials to reestablish turf that does not comply with requirements, and continue maintenance until turf is satisfactory.

3.7 PESTICIDE APPLICATION

A. Apply pesticides and other chemical products and biological control agents according to requirements of authorities having jurisdiction and manufacturer's written recommendations. Coordinate applications with Owner's operations and others in proximity to the Work. Notify Owner before each application is performed.

B. Post-Emergent Herbicides (Selective and Nonselective): Apply only as necessary to treat already-germinated weeds and according to manufacturer's written recommendations.

3.8 CLEANUP AND PROTECTION

A. Promptly remove soil and debris created by turf work from paved areas. Clean wheels of vehicles before leaving site to avoid tracking soil onto roads, walks, or other paved areas.

B. Remove surplus soil and waste material, including excess subsoil, unsuitable soil, trash, and debris, and legally dispose of them off Owner's property.

C. Erect temporary fencing or barricades and warning signs as required to protect newly planted areas from traffic. Maintain fencing and barricades throughout initial maintenance period and remove after plantings are established.

D. Remove nondegradable erosion-control measures after grass establishment period.

3.9 MAINTENANCE SERVICE

A. Turf Maintenance Service: Provide full maintenance by skilled employees of landscape Installer. Maintain as required in "Turf Maintenance" Article. Begin maintenance immediately after each area is planted and continue until acceptable turf is established, but for not less than the following periods:

1. Seeded Turf: 30 days from date of Substantial Completion.

    a. When initial maintenance period has not elapsed before end of planting season, or if turf is not fully established, continue maintenance during next planting season.

2. Maintenance Period: 40 days from date of Substantial Completion.

END OF SECTION 32 9200

SECTION 32 9300 - PLANTS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Plant materials.
2. Fertilizers.
3. Mulches.
4. Herbicides and pesticides.
5. Tree-stabilization materials.
6. Metal edging.

B. Related Requirements:

1. Section 12 9200 "Interior Planters and Artificial Plants" for planters for live and artificial interior plants.
2. Section 32 8400 "Irrigation" for complete irrigation systems.
3. Section 32 9200 "Turf and Grasses" for turf (lawn) and meadow planting, hydroseeding, and erosion-control materials.

1.2 COORDINATION

A. Coordination with Turf Areas (Lawns): Plant trees, shrubs, and other plants after finish grades are established and before planting turf areas unless otherwise indicated.

1. When planting trees, shrubs, and other plants after planting turf areas, protect turf areas, and promptly repair damage caused by planting operations.

1.3 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Plant Materials: Include quantities, sizes, quality, and sources for plant materials.
2. Plant Photographs: Include color photographs in digital format of each required species and size of plant material as it will be furnished to Project. Take photographs from an angle depicting true size and condition of the typical plant to be furnished. Include a scale rod or other measuring device in each photograph. For species where more than 20 plants are required, include a minimum of three photographs showing the average plant, the best

quality plant, and the worst quality plant to be furnished. Identify each photograph with the full scientific name of the plant, plant size, and name of the growing nursery.

B. Samples for Verification: For each of the following:

1. Trees and Shrubs: Three Samples of each variety and size delivered to site for review. Maintain approved Samples on-site as a standard for comparison.
2. Organic Mulch: 1-pint volume of each organic mulch required; in sealed plastic bags labeled with composition of materials by percentage of weight and source of mulch. Each Sample shall be typical of the lot of material to be furnished; provide an accurate representation of color, texture, and organic makeup.
3. Edging Materials and Accessories: Manufacturer's standard size, to verify color selected.

1.5 INFORMATIONAL SUBMITTALS

A. Field Quality-Control Reports: Percolation tests for tree pits. Include the following:

1. Tree identification number matching the plans.
2. Date of test.
3. Time when water was added to tree pit to start percolation test.
4. Time with photo documentation showing increments of testing with water level in tree pit.
5. Identification of tester.

B. Qualification Statements: For landscape Installer. Include list of similar projects completed by Installer demonstrating Installer's capabilities and experience. Include project names, addresses, and year completed, and include names and addresses of owners' contact persons.

C. Product Certificates: For each type of manufactured product, from manufacturer, and complying with manufacturer's certified analysis of standard products.

D. Pesticides and Herbicides: Product label and manufacturer's written application instructions specific to Project.

E. Sample Warranty: For special warranty.

1.6 CLOSEOUT SUBMITTALS

A. Maintenance Data: Recommended procedures to be established by Owner for maintenance of plants during a calendar year. Submit before expiration of required maintenance periods.

1.7 QUALITY ASSURANCE

A. Installer Qualifications: A qualified landscape installer whose work has resulted in successful establishment of plants.

1. Professional Membership: Member in good standing of either the National Association of Landscape Professionals or AmericanHort.
2. Experience: Five years' experience in landscape installation in addition to requirements in Section 01 4000 "Quality Requirements."
3. Installer's Field Supervision: Maintain an experienced full-time supervisor on Project site when work is in progress.
4. Personnel Certification: Installer's field supervisor certified in one of the following categories from the National Association of Landscape Professionals:

    a. Landscape Industry Certified Technician - Exterior.
    b. Landscape Industry Certified Interior.
    c. Landscape Industry Certified Horticultural Technician.

5. Pesticide Applicator: State licensed, commercial.

B. Provide quality, size, genus, species, and variety of plants indicated, complying with applicable requirements in ANSI Z60.1.

1. Selection of plants purchased under allowances is made by Architect, who tags plants at their place of growth before they are prepared for transplanting.

C. Measurements: Measure in accordance with ANSI Z60.1. Do not prune to obtain required sizes.

1. Trees and Shrubs: Measure with branches and trunks or canes in their normal position. Take height measurements from or near the top of the root flare for field-grown stock and container-grown stock. Measure main body of tree or shrub for height and spread; do not measure branches or roots tip to tip. Take caliper measurements 6 inches above the root flare for trees up to 4-inch caliper size, and 12 inches above the root flare for larger sizes.
2. Other Plants: Measure with stems, petioles, and foliage in their normal position.

D. Plant Material Observation: Architect may observe plant material either at place of growth or at site before planting for compliance with requirements for genus, species, variety, cultivar, size, and quality. Architect may also observe trees and shrubs further for size and condition of balls and root systems, pests, disease symptoms, injuries, and latent defects and may reject unsatisfactory or defective material at any time during progress of work. Remove rejected trees or shrubs immediately from Project site.

1. Notify Architect of sources of planting materials seven days in advance of delivery to site.

1.8 DELIVERY, STORAGE, AND HANDLING

A. Packaged Materials: Deliver packaged materials in original, unopened containers showing weight, certified analysis, name and address of manufacturer, and indication of compliance with state and Federal laws if applicable.

B. Bulk Materials:

1. Do not dump or store bulk materials near structures, utilities, or walkways and pavements; or on existing turf areas or plants.
2. Provide erosion-control measures to prevent erosion or displacement of bulk materials; discharge of soil-bearing water runoff; and airborne dust reaching adjacent properties, water conveyance systems, or walkways.
3. Accompany each delivery of bulk materials with appropriate certificates.

C. Do not prune trees and shrubs before delivery. Protect bark, branches, and root systems from sun scald, drying, wind burn, sweating, whipping, and other handling and tying damage. Do not bend or bind-tie trees or shrubs in such a manner as to destroy their natural shape. Provide protective covering of plants during shipping and delivery. Do not drop plants during delivery and handling.

D. Handle planting stock by root ball.

E. Store bulbs, corms, and tubers in a dry place at 60 to 65 deg F until planting.

F. Apply antidesiccant to trees and shrubs using power spray to provide an adequate film over trunks (before wrapping), branches, stems, twigs, and foliage to protect during digging, handling, and transportation.

1. If deciduous trees or shrubs are moved in full leaf, spray with antidesiccant at nursery before moving and again two weeks after planting.

G. Wrap trees and shrubs with burlap fabric over trunks, branches, stems, twigs, and foliage to protect from wind and other damage during digging, handling, and transportation.

H. Deliver plants after preparations for planting have been completed, and install immediately. If planting is delayed more than six hours after delivery, set plants and trees in their appropriate aspect (sun, filtered sun, or shade), protect from weather and mechanical damage, and keep roots moist.

1. Heel-in bare-root stock. Soak roots that are in less than moist condition in water for two hours. Reject plants with dry roots.
2. Set balled stock on ground and cover ball with soil, peat moss, sawdust, or other acceptable material.
3. Do not remove container-grown stock from containers before time of planting.
4. Water root systems of plants stored on-site deeply and thoroughly with a fine-mist spray. Water as often as necessary to maintain root systems in a moist, but not overly wet condition.

1.9 FIELD CONDITIONS

A. Field Measurements: Verify actual grade elevations, service and utility locations, irrigation system components, and dimensions of plantings and construction contiguous with new plantings by field measurements before proceeding with planting work.

B. Planting Restrictions: Plant during one of the following periods. Coordinate planting periods with maintenance periods to provide required maintenance from date of Substantial Completion.

1. Spring Planting: April 15-June 15.
2. Fall Planting: August 15-October 15.

C. Weather Limitations: Proceed with planting only when existing and forecasted weather conditions permit planting to be performed when beneficial and optimum results may be obtained. Apply products during favorable weather conditions in accordance with manufacturer's written instructions and warranty requirements.

1.10 WARRANTY

A. Special Warranty: Installer agrees to repair or replace plantings and accessories that fail in materials, workmanship, or growth within specified warranty period.

1. Failures include, but are not limited to, the following:

a. Death and unsatisfactory growth, except for defects resulting from abuse, lack of adequate maintenance, or neglect by Owner.
b. Structural failures, including plantings falling or blowing over.
c. Faulty performance of tree stabilization.
d. Deterioration of metals, metal finishes, and other materials beyond normal weathering.

2. Warranty Periods: From date of Substantial Completion.

a. Trees, Shrubs, Vines, and Ornamental Grasses: 12 months.
b. Ground Covers, Biennials, Perennials, and Other Plants: 12 months.

3. Include the following remedial actions as a minimum:

a. Immediately remove dead plants and replace unless required to plant in the succeeding planting season.
b. Replace plants that are more than 25 percent dead or in an unhealthy condition at end of warranty period.
c. A limit of one replacement of each plant is required except for losses or replacements due to failure to comply with requirements.
d. Provide extended warranty for period equal to original warranty period, for replaced plant material.

PART 2 - PRODUCTS

2.1 PLANT MATERIALS

A. General: Furnish nursery-grown plants true to genus, species, variety, cultivar, stem form, shearing, and other features indicated in Plant List, Plant Schedule, or Plant Legend indicated on Drawings and complying with ANSI Z60.1; and with healthy root systems developed by transplanting or root pruning. Provide well-shaped, fully branched, healthy, vigorous stock,

densely foliated when in leaf and free of disease, pests, eggs, larvae, and defects such as knots, sun scald, injuries, abrasions, and disfigurement.

1. Trees with damaged, crooked, or multiple leaders; with tight vertical branches where bark is squeezed between two branches or between branch and trunk ("included bark"); with crossing trunks; with cut-off limbs more than 3/4 inch in diameter; or with stem girdling roots are unacceptable.
2. Collected Stock: Do not use plants harvested from the wild, from native stands, from an established landscape planting, or not grown in a nursery unless otherwise indicated.

B. Provide plants of sizes, grades, and ball or container sizes complying with ANSI Z60.1 for types and form of plants required. Plants of a larger size may be used if acceptable to Architect, with a proportionate increase in size of roots or balls.

C. Root-Ball Depth: Furnish trees and shrubs with root balls measured from top of root ball, which begins at root flare in accordance with ANSI Z60.1.

D. Labeling: Label at least one plant of each variety, size, and caliper with a securely attached, waterproof tag bearing legible designation of common name and full scientific name, including genus and species. Include nomenclature for hybrid, variety, or cultivar, if applicable for plant.

E. If formal arrangements or consecutive order of plants is indicated on Drawings, select stock for uniform height and spread, and number the labels to ensure symmetry in planting.

2.2 FERTILIZERS

A. Planting Tablets: Tightly compressed chip-type, long-lasting, slow-release, commercial-grade planting fertilizer in tablet form. Tablets shall break down with soil bacteria, converting nutrients into a form that can be absorbed by plant roots.

1. Size: 5-gram tablets.
2. Nutrient Composition: 20 percent nitrogen, 10 percent phosphorous, and 5 percent potassium, by weight plus micronutrients.

2.3 MULCHES

A. Mineral Mulch: Via Logan Landscape Products, 750 North 1152 West Logan, Utah 84321, 435-752-9999. Hard, durable stone, washed free of loam, sand, clay, and other foreign substances, of the following type, size range, and color:

1. Type: River Rock, smooth stone, with grays and purples mixed
2. Size Range: 2-3” minus.
3. Color: South Towne Beige.

B. Organic Mulch: Via Logan Landscape Products, 750 North 1152 West Logan, Utah 84321, 435-752-9999. Free from deleterious materials and suitable as a top dressing of trees and shrubs, consisting of one of the following:

1. Type: Small Nuggets, natural red fir bark nuggets.
2. Size Range: 2” minus.
3. Color: Natural.

2.4 HERBICIDES AND PESTICIDES

A. Pre-Emergent Herbicide (Selective and Nonselective): Effective for controlling the germination or growth of weeds within planted areas at the soil level directly below the mulch layer.

B. Post-Emergent Herbicide (Selective and Nonselective): Effective for controlling weed growth that has already germinated.

C. Pesticides: Registered and approved by the EPA, acceptable to authorities having jurisdiction, and of type recommended in writing by manufacturer for each specific problem and as required for Project conditions and application. Do not use restricted pesticides unless authorized in writing by authorities having jurisdiction.

2.5 ROOT-BALL STABILIZATION MATERIALS

A. Root-Ball Stabilization Materials:

1. Proprietary Root-Ball Stabilization Devices: Proprietary at- or below-grade stabilization systems to secure each new planting by root ball and that do not encircle the trunk; sized according to manufacturer's written recommendations unless otherwise indicated.

    a. ARBOR STAKES, LLC. (www.arborstakes.com)

    b. Biodegradability
        1) 99.9% of apparatus components shall have the ability of being decomposed by biological / microbial / fungal inoculant soilborne activity.

    c. Biodegradable Stake
        1) Quantity as specified (per tree basis)
        2) Wooden dowel rods meeting >6% moisture content. ASTM D4442
        3) Length 40” (inches)
        4) Diameter 22.2mm (millimeters)

    d. Biodegradable Lock
        1) (1) per Biodegradable Stake (above)
        2) TOTAL HEIGHT NOT TO EXCEED 1” FROM TOP OF ROOT BALL

2.6 LANDSCAPE EDGINGS

A. Cor Ten Steel Edging: Standard commercial-steel edging, fabricated in sections of standard lengths, with loops stamped from or welded to face of sections to receive stakes.

1. Manufacturers: Subject to compliance with requirements, provide products by the following:

    a. Edge Right.

2. Edging Size: 1/4 inch thick by 8 inch deep.
3. Accessories: Standard tapered ends, corners, and splicers, protective edge guard (by Manufacturer).
4. Finish: Unfinished.

2.7

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas to receive plants, with Installer present, for compliance with requirements and conditions affecting installation and performance of the Work.

1. Verify that no foreign or deleterious material or liquid such as paint, paint washout, concrete slurry, concrete layers or chunks, cement, plaster, oils, gasoline, diesel fuel, paint thinner, turpentine, tar, roofing compound, or acid has been deposited in soil within a planting area.
2. Verify that plants and vehicles loaded with plants can travel to planting locations with adequate overhead clearance.
3. Suspend planting operations during periods of excessive soil moisture until moisture content reaches acceptable levels to attain required results.
4. Uniformly moisten excessively dry soil that is not workable or which is dusty.

B. If contamination by foreign or deleterious material or liquid is present in soil within a planting area, remove soil and contamination as directed by Architect and replace with new planting soil.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Protect structures, utilities, sidewalks, pavements, and other facilities and turf areas and existing plants from damage caused by planting operations.

B. Install erosion-control measures to prevent erosion or displacement of soils and discharge of soil-bearing water runoff or airborne dust to adjacent properties and walkways.

C. Lay out individual tree and shrub locations and areas for multiple plantings. Stake locations, outline areas, adjust locations when requested, and obtain Architect's acceptance of layout before excavating or planting. Make minor adjustments as required.

D. Lay out plants at locations directed by Architect. Stake locations of individual trees and shrubs and outline areas for multiple plantings.

3.3 PLANTING AREA ESTABLISHMENT

A. General: Prepare planting area for soil placement and mix planting soil in accordance with Section 32 9115 "Soil Preparation (Performance Specification)."

B. Placing Planting Soil: Place and mix planting soil in-place over exposed subgrade.

C. Before planting, obtain Architect's acceptance of finish grading; restore planting areas if eroded or otherwise disturbed after finish grading.

D. Application of Mycorrhizal Fungi: At time directed by Architect, broadcast dry product uniformly over prepared soil at application rate in accordance with manufacturer's written instructions.

3.4 EXCAVATION FOR TREES AND SHRUBS

A. Planting Pits and Trenches: Excavate circular planting pits.

1. Excavate planting pits with sides sloping inward at a 45-degree angle. Excavations with vertical sides are unacceptable. Trim perimeter of bottom leaving center area of bottom raised slightly to support root ball and assist in drainage away from center. Do not further disturb base. Ensure that root ball will sit on undisturbed base soil to prevent settling. Scarify sides of planting pit smeared or smoothed during excavation.
2. Excavate approximately three times as wide as ball diameter for balled and burlapped container-grown stock.
3. Excavate at least 12 inches wider than root spread and deep enough to accommodate vertical roots for bare-root stock.
4. Do not excavate deeper than depth of root ball, measured from the root flare to the bottom of root ball.
5. If area under the plant was initially dug too deep, add soil to raise it to correct level and thoroughly tamp the added soil to prevent settling.
6. Maintain angles of repose of adjacent materials to ensure stability. Do not excavate subgrades of adjacent paving, structures, hardscapes, or other new or existing improvements.
7. Maintain supervision of excavations during working hours.
8. Keep excavations covered or otherwise protected when unattended by Installer's personnel.
9. If drain tile is indicated on Drawings or required under planting areas, excavate to top of porous backfill over tile.

B. Backfill Soil: Subsoil and topsoil removed from excavations may be used as backfill soil unless otherwise indicated.

C. Obstructions: Notify Architect if unexpected rock or obstructions detrimental to trees or shrubs are encountered in excavations.

1. Hardpan Layer: Drill 6-inch-diameter holes, 24 inches apart, into free-draining strata or to depth of 10 ft., whichever is less, and backfill with free-draining material.

D. Drainage: Notify Architect if subsoil conditions evidence unexpected water seepage or retention in tree or shrub planting pits.

E. Fill excavations with water and allow to percolate away before positioning trees and shrubs.

3.5 TREE, SHRUB, AND VINE PLANTING

A. Inspection: At time of planting, verify that root flare is visible at top of root ball in accordance with ANSI Z60.1. If root flare is not visible, remove soil in a level manner from root ball to where the top-most root emerges from the trunk. After soil removal to expose root flare, verify that root ball still meets size requirements.

B. Roots: Remove stem girdling roots and kinked roots. Remove injured roots by cutting cleanly; do not break.

C. Balled and Burlapped Stock: Set each plant plumb and in center of planting pit or trench with root flare 1 inch above adjacent finish grades.

1. Backfill: Planting soil, use 50% excavated soil, 50% amended soil for backfill.
2. After placing some backfill around root ball to stabilize plant, carefully cut and remove burlap, rope, and wire baskets from tops of root balls and from sides, but do not remove from under root balls. Remove pallets, if any, before setting. Do not use planting stock if root ball is cracked or broken before or during planting operation.
3. Backfill around root ball in layers, tamping to settle soil and eliminate voids and air pockets. When planting pit is approximately one-half filled, water thoroughly before placing remainder of backfill. Repeat watering until no more water is absorbed.
4. Distribute granular fertilizer around each planting pit when pit is approximately one-half filled. Do not place in bottom of the hole.

    a. Quantity: Two per plant.

5. Continue backfilling process. Water again after placing and tamping final layer of soil.

D. Container-Grown Stock: Set each plant plumb and in center of planting pit or trench with root flare 1 inch above adjacent finish grades.

1. Backfill: Planting soil, use 50% excavated soil, 50% amended soil for backfill.
2. After placing some backfill around root ball to stabilize plant, carefully cut and remove burlap, rope, and wire baskets from tops of root balls and from sides, but do not remove from under root balls. Remove pallets, if any, before setting. Do not use planting stock if root ball is cracked or broken before or during planting operation.
3. Backfill around root ball in layers, tamping to settle soil and eliminate voids and air pockets. When planting pit is approximately one-half filled, water thoroughly before placing remainder of backfill. Repeat watering until no more water is absorbed.
4. Distribute granular fertilizer around each planting pit when pit is approximately one-half filled. Do not place in bottom of the hole.

a. Quantity: Two per plant.

5. Continue backfilling process. Water again after placing and tamping final layer of soil.

3.6 MECHANIZED TREE-SPADE PLANTING

A. Plant trees with approved mechanized tree spade at designated locations. Do not use tree spade to move trees larger than maximum size allowed for similar field-grown, balled-and-burlapped, root-ball diameter in accordance with ANSI Z60.1, or trees larger than manufacturer's maximum size recommendation for tree spade being used, whichever is smaller.

B. Use same tree spade to excavate the planting hole as will be used to extract and transport the tree.

C. When extracting tree, center the trunk within the tree spade and move tree with solid ball of earth.

D. Cut exposed roots cleanly during transplanting operations.

E. Plant trees following procedures in "Tree, Shrub, and Vine Planting" Article.

F. Where possible, orient the tree in same direction as in its original location.

3.7 TREE, SHRUB, AND VINE PRUNING

A. Remove only dead, dying, or broken branches. Do not prune for shape.

B. Prune, thin, and shape trees, shrubs, and vines as directed by Architect.

C. Prune, thin, and shape trees, shrubs, and vines in accordance with standard professional horticultural and arboricultural practices. Unless otherwise indicated by Architect, do not cut tree leaders; remove only injured, dying, or dead branches from trees and shrubs; and prune to retain natural character.

D. Do not apply pruning paint to wounds.

3.8 INSTALLATION OF TREE-STABILIZATION MATERIALS

A. Trunk Stabilization by Upright Staking and Tying: Install trunk stabilization as follows unless otherwise indicated:

1. Upright Staking and Tying:

a. Stake trees of 2- through 5-inch caliper. Stake trees of less than 2-inch caliper only as required to prevent wind tip out. Use a minimum of two stakes of length required to penetrate at least 18 inches below bottom of backfilled excavation and to extend at least 72 inches above grade. Set vertical stakes and space to avoid penetrating root balls or root masses.

b. Stake trees with two stakes for trees up to 12 ft. high and 2-1/2 inches or less in caliper; three stakes for trees less than 14 ft. high and up to 4 inches in caliper. Space stakes equally around trees.

2. Support trees with bands of flexible ties at contact points with tree trunk. Allow enough slack to avoid rigid restraint of tree.
3. Support trees with two strands of tie wire, connected to the brass grommets of tree-tie webbing at contact points with tree trunk. Allow enough slack to avoid rigid restraint of tree.

3.9 GROUND COVER AND PLANT PLANTING

A. Set out and space ground cover and plants other than trees, shrubs, and vines as indicated on Drawings in even rows with triangular spacing.

B. Use planting soil for backfill.

C. Dig holes large enough to allow spreading of roots.

D. For rooted cutting plants supplied in flats, plant each in a manner that minimally disturbs the root system but to depth not less than two nodes.

E. Work soil around roots to eliminate air pockets and leave slight saucer indentation around plants to hold water.

F. Water thoroughly after planting, taking care not to cover plant crowns with wet soil.

G. Protect plants from hot sun and wind; remove protection if plants show evidence of recovery from transplanting shock.

3.10 INSTALLATION OF MULCHES

A. Mulch backfilled surfaces of planting areas and other areas indicated.

1. Trees and Treelike Shrubs in Turf Areas: Apply mineral mulch ring of 2-inch average thickness, with 12-inch radius around trunks or stems. Do not place mulch within 3 inches of trunks or stems.
2. Mineral Mulch in Planting Areas: Apply 3-inch average thickness of mineral mulch extending 12 inches beyond edge of individual planting pit or trench and over whole surface of planting area, and finish level with adjacent finish grades. Do not place mulch within 3 inches of trunks or stems.

3.11 APPLICATION OF HERBICIDES AND PESTICIDES

A. Pre-Emergent Herbicides (Selective and Nonselective): Apply to tree, shrub, and ground-cover areas in accordance with manufacturer's written instructions. Do not apply to seeded areas.

B. Post-Emergent Herbicides (Selective and Nonselective): Apply only as necessary to treat already-germinated weeds and in accordance with manufacturer's written instructions.

C. Apply pesticides and other chemical products and biological control agents according to authorities having jurisdiction and in accordance with manufacturer's written instructions. Coordinate applications with Owner's operations and others in proximity to the Work. Notify Owner before each application is performed.

3.12 PLANT MAINTENANCE

A. Maintain plantings by pruning, cultivating, watering, weeding, fertilizing, mulching, restoring planting saucers, adjusting and repairing tree-stabilization devices, resetting to proper grades or vertical position, and performing other operations as required to establish healthy, viable plantings.

B. Fill in, as necessary, soil subsidence that may occur because of settling or other processes. Replace mulch materials damaged or lost in areas of subsidence.

C. Apply treatments as required to keep plant materials, planted areas, and soils free of pests and pathogens or disease. Use integrated pest management practices when possible to minimize use of pesticides and reduce hazards. Treatments include physical controls such as hosing off foliage, mechanical controls such as traps, and biological control agents.

3.13 FIELD QUALITY CONTROL

A. Testing Agency: Owner will engage a qualified testing agency to perform tests and inspections.

B. Tests and Inspections:

1. Perform tree pit percolation tests.
2. Tree pit construction will be considered defective if it does not pass percolation tests and inspections.
3. Do not proceed with planting in tree pits until satisfactory percolation is demonstrated.

C. Prepare test and inspection reports.

3.14 REPAIR AND REPLACEMENT

A. Repair or replace existing or new trees and other plants that are damaged by construction operations, in a manner approved by Architect.

1. Submit details of proposed pruning and repairs.
2. Perform repairs of damaged trunks, branches, and roots within 24 hours, if approved.
3. Replace trees and other plants that cannot be repaired and restored to full-growth status, as determined by Architect.

B. Remove and replace trees that are more than 25 percent dead or in unhealthy condition before end of corrections period or are damaged during construction operations that Architect determines are incapable of restoring to normal growth pattern.

1. Provide new trees of same size as those being replaced for each tree of 4 inches or smaller in caliper size.
2. Provide one new tree(s) of 4-inch caliper size for each tree being replaced that measures more than 4 inches in caliper size.
3. Species of Replacement Trees: Same species being replaced.

3.15 CLEANING AND PROTECTION

A. During planting, keep adjacent paving and construction clean and work area in an orderly condition. Clean wheels of vehicles before leaving site to avoid tracking soil onto roads, walks, or other paved areas.

B. Remove surplus soil and waste material including excess subsoil, unsuitable soil, trash, and debris and legally dispose of them off Owner's property.

C. Protect plants from damage due to landscape operations and operations of other contractors and trades. Maintain protection during installation and maintenance periods. Treat, repair, or replace damaged plantings.

D. After installation and before Substantial Completion, remove nursery tags, nursery stakes, tie tape, labels, wire, burlap, and other debris from plant material, planting areas, and Project site.

E. At time of Substantial Completion, verify that tree-watering devices are in good working order and leave them in place. Replace improperly functioning devices.

END OF SECTION 32 9300

APPENDIX No. 1 – CIVIL SITEWORK

1.1 AMERICAN PUBLIC WORKS ASSOCIATION (APWA) STANDARD SPECIFICATIONS

A. Portions of the Manual of Standard Specifications, as provided by The American Public Works Association (APWA), are included in this Project, as follows:

DIVISION 01 GENERAL REQUIREMENTS
- Section 01 45 00 Quality Control
- Section 01 55 26 Traffic Control
- Section 01 57 00 Temporary Controls
- Section 01 71 13 Mobilization and Demobilization
- Section 01 71 23 Construction Layout

DIVISION 02 EXISTING CONDITIONS
- Section 02 41 13 Selective Site Demolition
- Section 02 41 19 Selective Building Demolition

DIVISION 31 EARTH WORK
- Section 31 05 13 Common Fill
- Section 31 11 00 Site Clearing
- Section 31 23 16 Excavation
- Section 31 23 23 Backfilling for Structures
- Section 31 23 26 Compaction

DIVISION 32 EXTERIOR IMPROVEMENTS
- Section 32 16 13 Driveway, Sidewalk, Curb, Gutter
- Section 32 91 19 Landscape Grading

DIVISION 33 UTILITIES
- Section 33 12 33 Water Meters
- Section 33 31 00 Sanitary Sewerage Systems
- Section 33 41 00 Drainage Systems
- Section 33 71 73 Electrical Utility Services

1.2 Specifications included in this Appendix are applicable to sitework only.

SECTION 01 45 00

QUALITY CONTROL

PART 1 GENERAL

1.1 SECTION INCLUDES

A. CONTRACTOR responsibilities for quality control.

1.2 QUALITY ASSURANCE

A. Employ an agency or staff to assure installed product and materials comply with Contract Documents, and to assure inspections, tests, and other services comply with industry standards.

B. Use an AMRL (AASHTO Materials Reference Library) certified laboratory that has personnel certified by WAQTC (Western Alliance for Quality Transportation Construction).

C. When requested by ENGINEER, provide a professional opinion from a testing agency concerning test results and quality of work covered by testing performed.

D. Do more testing, if, in ENGINEER's opinion, work is not being adequately controlled.

1.3 TESTING AGENCY

A. Provide sufficient personnel and cooperate with ENGINEER and CONTRACTOR in performing testing service.

B. Obtain and secure samples using procedures specified in the applicable testing code.

C. Perform product testing in accordance with applicable requirements of the Contract Documents.

D. Correlate tests with ENGINEER's acceptance tests.

E. When an out-of-tolerance condition exists, perform additional control testing until tolerance is attained.

F. Report any non-compliance of materials and mixes to CONTRACTOR and ENGINEER immediately.

1.4 SUBMITTALS – CONTRACTOR

A. **Before Construction**: Identify:

1. Name, address and telephone number of testing agency.
2. Person whom agency has charged with engineering managerial responsibility.
3. Licensed professional for testing agency who is to review services.
4. Names and levels of certification and years of experience of testing agency's laboratory and field technicians.

B. **During Construction**: Submit quality control test data requested by ENGINEER to demonstrate work performed complies with Contract Documents.

1.5 **SUBMITTALS – TESTING AGENCY**

A. **During Construction**: Submit field test results immediately to ENGINEER and CONTRACTOR or not later than day of test. Submit laboratory test results within 48 hours of determination.

B. **After Construction**: Submit a final summary report in tabular form. Show each failed test and its corresponding passing test.

C. **Reports**: Include on all reports:

1. Project title, number and date.
2. Date, time and location of test.
3. Name and address of material Supplier.
4. Identification of product being tested and type of test.
5. Testing results and interpretation of results.
6. Name of technician(s) who sampled and who performed test.

1.6 **LIMITS ON TESTING AGENCY**

A. Agency may not release, revoke, alter, or enlarge on requirements of Contract Documents.

B. Agency may not suspend work.

C. Agency has no authority to determine acceptance for ENGINEER.

D. Samples must be collected and secured only by the testing agency.

PART 2 PRODUCTS

2.1 **MATERIALS**

A. Material furnished from sources that have been found satisfactory under OWNER's or ENGINEER's normal testing and sampling procedures may be used in the Work.

B. Materials that are supported with a Supplier's certificate of compliance may be used in the Work. Certificate must be in possession of CONTRACTOR for review by ENGINEER before use.

PART 3 EXECUTION Not Used

END OF SECTION

SECTION 01 55 26
TRAFFIC CONTROL

PART 1 GENERAL

1.1 **SECTION INCLUDES**

A. Traffic control requirements.

1.2 **REFERENCES**

A. ASTM D4956: Retroreflective Sheeting for Traffic Control.

B. ATSSA: American Traffic Safety Services Association, Inc.

C. Instructions to Flaggers. Publication of UDOT.

D. MUTCD: Manual on Uniform Traffic Control Devices for Streets and Highways.

E. Work Zone Traffic Control Guide: Publication of the Utah LTAP Center.

1.3 **SUBMITTALS**

A. Traffic control plan within 10 days of receiving the Notice of Intent to Award.

B. Flagger or traffic control technician certificates when requested by ENGINEER.

1.4 **TRAFFIC CONTROL PLAN**

A. Create a traffic control plan using the following resources. Resolve discrepancies between resources in descending order shown:

1. MUTCD.
2. Work Zone Traffic Control Guide.
3. ATSSA.

B. Include the following documentation as part of the traffic control plan.

1. Written description of phasing.
2. Drawing showing phasing (if required for clarity).
3. Drawing showing placement of traffic control devices.

C. Show how to move pedestrians through or around the Work site.

D. Show how to handle signalized intersections.

E. Meet grade, slope and protection requirement of the Americans with Disabilities Act (ADA).

1.5 **TRAFFIC CONTROL TECHNICIAN**

A. Certified by ATSSA or AGC.

1.6 **FLAGGER**

A. Certified by ATSSA, AGC or UDOT.

B. Equipment:
   1. 24” x 24” “Stop/Slow” sign.
   2. 6” to 8” long red wand for night flagging.
   3. Light plant for night flagging.

C. Clothing:
   1. Clothed; full length pants and long or short sleeved shirt.
   2. Hard toed shoes.
   3. Lime Green, orange, or red-orange hardhat and vest.
   4. Night clothing to be reflectorized.

PART 2 PRODUCTS

2.1 PAVEMENT MARKINGS, SIGNS, BARRICADES

A. MUTCD.

B. Channelizing Devices: Crash worthy plastic cones, drums and barricades.

C. Reflective Sheeting: ASTM D4956.

D. Pavement Markings: Section 32 17 23.

PART 3 EXECUTION

3.1 FLAGGING

A. MUTCD.

3.2 TRAFFIC CONTROL DEVICES

A. Install before work activities begin.

B. Maintain to ensure proper, continuous function.

C. Remove when no longer needed.

3.3 TEMPORARY PAVEMENT MARKINGS

A. Renew if stripes and markings have lost their original visual effectiveness.

END OF SECTION

SECTION 01 57 00

TEMPORARY CONTROLS

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Requirements for controlling surface and subsurface environmental conditions at a construction site, and related areas under the CONTRACTOR's responsibility.

B. Requirements for removal of physical evidence of temporary controls upon completion of the Work.

PART 2 PRODUCTS

2.1 MATERIALS

A. Temporary Materials: CONTRACTOR's choice.

PART 3 EXECUTION

3.1 NOISE CONTROL

A. Use equipment that is equipped with noise attenuation devises. Comply with local Laws and Regulations.

B. Control construction noise in residential areas from 9:00 pm to 7:00 am.

3.2 DUST AND MUD CONTROL

A. Comply with Utah State air quality regulations.

B. Provide suitable equipment to control dust or air pollution caused by construction operations.

C. Provide suitable mud and dirt containment, so Work site, access roadways and properties adjacent to the Work site are kept clean.

3.3 SURFACE WATER CONTROL

A. Control all on-site surface water. Provide proper drainage so flooding of the site or adjacent property does not occur.

B. Provide and maintain ample means and devices with which to promptly remove and properly dispose of all water entering the site.

C. Immediately before suspension of construction operations for any reason, provide proper and necessary drainage of Work site area.

D. Provide berms or channels as necessary to prevent flooding or saturation of Subgrade. Promptly remove all water collecting in depressions.

E. Dispose of water in a manner that will not cause damage to adjacent areas or facilities.

3.4 **GROUND WATER CONTROL**

A. Provide a dewatering system sufficient to maintain excavations and foundations dry and free of water on a 24 hour basis.

B. Notify ENGINEER, in writing, if groundwater conditions differ from conditions shown in the Bid Documents, or in any soil test data that has been supplied.

C. Remove all dewatering facilities when no longer required.

D. Dispose of water in a manner that will not cause damage to adjacent or downstream areas or facilities.

3.5 **POLLUTION CONTROL**

A. **Soil**: Prevent contamination of soil from discharge of noxious substances (including engine oils, fuels, lubricants, etc.). Excavate and legally dispose of any such contaminated soil off-site, and replace with acceptable compacted fill and topsoil.

B. **Water**: Prevent disposal of wastes, effluent, chemicals, or other such substances adjacent to or into streams, waterways, sanitary sewers, storm drains, or public waterways. Perform any emergency measures required to contain any spillage.

C. **Air**: Control atmospheric pollutants.

3.6 **EROSION CONTROL**

A. Use measures such as berms, dikes, dams, sediment basins, fiber mat netting, gravel, mulches, slopes, drains and other erosion control devices or methods to prevent erosion and sedimentation.

B. Provide construction and earthwork methods which control surface drainage from cut, fill, borrow, and waste disposal areas, to prevent erosion and sedimentation.

C. Inspect earthwork during execution to detect any evidence of the start of erosion. Apply corrective measures as required.

END OF SECTION

SECTION 01 71 13

MOBILIZATION AND DEMOBILIZATION

PART 1 GENERAL

1.1 **SECTION INCLUDES**

A. Mobilization and demobilization requirements.

1.2 **REFERENCES**

A. **APWA (Utah) Standards**:

Plan 412 Invert Cover.

1.3 **DEFINITIONS**

A. **Mobilization** includes bringing all necessary equipment to the site to do the Work. It includes all labor, materials, and equipment to set up temporary offices, buildings, facilities, signs, and utilities.

B. **Demobilization** includes removing all construction equipment and debris so site is left clean.

1.4 **TEMPORARY FACILITIES**

A. Field Office: CONTRACTOR's choice.

B. Utilities: Provide power, telephone, water, storm and sanitary facilities, and all other temporary utilities required.

C. Security and Protection: Construct and maintain temporary fencing for the protection of materials, tools, and equipment. Obtain prior approval for all fence locations.

D. Construction and Support: Set up and maintain in a neat and orderly manner temporary roads and paving, dewatering facilities, enclosures, identification signs and bulletin boards, waste disposal and temporary heat. Provide and maintain temporary all weather pedestrian walk ways and road detours.

E. Invert Cover: Install covers as shown in APWA Plan 412 or Drawings. Installation must be tight so no debris can by-pass the cover and enter the piping below.

PART 2 PRODUCTS

2.1 **MATERIALS**

A. Temporary Materials: CONTRACTOR's choice.

PART 3 EXECUTION

3.1 INSTALLATIONS

A. Relocate and modify temporary facilities as required.

B. Install temporary utility service or connect to existing service.

C. Locate field offices, storage sheds, sanitary facilities and other temporary construction and support facilities for easy access. Use of gasoline-burning, open flame, or salamander type heating units is prohibited.

D. Use local standards and codes for erection of adequate fences and barricades. Maintain all signing, barricades, fencing, drainage, and other items as required to protect public and private property from damage caused by construction operations.

E. Coordinate location of storage areas to avoid interference with drainage, traffic, or private property.

F. Provide and maintain all temporary signage required by the Work.

3.2 REMOVALS

A. Completely remove temporary materials and equipment:

1. When construction needs can be met beause of permanent installation, and
2. At completion of the Work.

B. Clean or repair damage caused by installation or use of temporary facilities.

C. Restore areas to original or to specified conditions at completion of the Work.

END OF SECTION

SECTION 01 71 23

CONSTRUCTION LAYOUT

PART 1 GENERAL

1.1 **SECTION INCLUDES**

A. Construction surveying requirements.

1.2 **SUBMITTALS**

A. Before contract closeout submit:

1. Documentation to verify accuracy of survey work.
2. When required by Laws and Regulations, submit a certificate signed by a licensed professional certifying that elevations and locations of improvements conform with the Contract Documents.
3. All survey data, survey information showing dimensions, location angles and elevations of construction on contract Record Documents.

1.3 **SURVEY REFERENCE POINTS**

A. Known basic horizontal and vertical control points for the Project are indicated.

B. Locate and protect survey control points before starting site work, and preserve all permanent reference points during construction.

C. Notify ENGINEER in writing within 24 hours of any survey work changes or clarifications required for Project. Secure written authorization before making any changes or relocations.

D. Report in writing when any reference point is lost or destroyed, or requires relocation because of necessary changes in grades or locations.

E. Replace construction stakes damaged or destroyed by CONTRACTOR at no additional cost to OWNER.

PART 2 PRODUCTS Not used

PART 3 EXECUTION

3.1 PROJECT SURVEY REQUIREMENTS

A. Any work done without line and grade established by CONTRACTOR is at CONTRACTOR's own risk.

B. Locate and layout by instrumentation and similar appropriate means to include but not limited to:

1. Pavement subgrade and finish grade.
2. Site improvements:
    a. Stakes for grading, fill and topsoil placement.
    b. Slope elevations.
    c. Utility locations and invert elevations.
3. Batter boards for structures.
4. Retaining wall locations and elevations.
5. Curb and gutter alignment and grade.
6. Building foundations, column locations and floor levels.
7. Controlling lines and levels required for civil, mechanical, and electrical trades.

END OF SECTION

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 19

SELECTIVE BUILDING DEMOLITION

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Removal of building components.

1.2 DEFINITIONS

A. **Remove**: Remove and legally dispose of items except those indicated to be reinstalled, salvaged, or to remain OWNER's property unless indicated otherwise by ENGINEER.

B. **Remove and Salvage**: Items indicated to be removed and salvaged remain OWNER's property. Remove, clean, and pack or crate items to protect against damage. Identify contents of containers and deliver to OWNER's designated storage area.

C. **Remove and Reinstall**: Remove items indicated. Clean, service, and otherwise prepare them for re- use. Store and protect against damage. Reinstall them in locations indicated.

D. **Existing to Remain**: Protect construction indicated to remain against damage and soiling during selective demolition. When permitted by ENGINEER, items may be removed to a suitable, protected storage location during selective demolition and then cleaned and reinstalled in their original locations.

1.3 PROJECT CLOSEOUT

A. Record removals on Drawings. Submit Record Documents, Section 01 78 39.

PART 2 PRODUCTS Not Used

PART 3 EXECUTION

3.1 PREPARATION

A. Survey condition of building to determine whether removing any element might result in structural deficiency or unplanned collapse of any portion of structure or adjacent structures during selective demolition.

B. All furnishing, accessories, equipment, etc. that are to be removed from site shall remain property of OWNER. ENGINEER shall determine appropriate action for property in question.

C. If OWNER occupies portions of building immediately adjacent to selective demolition area, conduct selective demolition so OWNER's operations will not be disrupted. Provide not less than 72 hours notice to OWNER of activities that will affect OWNER's operations. Also submit 72 hour notifications to ENGINEER.

D. OWNER assumes no responsibility for actual condition of buildings to be selectively demolished.

3.2 **DEMOLITION**

A. Comply with Laws and Regulations before, during, and after selective demolition. Comply with hauling and disposal regulations of authorities having jurisdiction.

B. Photograph or videotape existing conditions of adjoining construction and site improvements that might be misconstrued as damage caused by selective demolition operations.

C. Storage or sale of removed items or materials on site will not be permitted.

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 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 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 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

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 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 I**NSTALLATION - 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 71 73

ELECTRICAL UTILITY SERVICES

PART 1 GENERAL

1.1 **SECTION INCLUDES**

A. Under ground and above ground electrical service systems.

1.2 **REFERENCES**

A. **NFPA Standards**:

70 National Electric Code.

1.3 **PERFORMANCE REQUIREMENTS**

A. Conform to.

1. NFPA 70.
2. Electrical authority having jurisdiction.

PART 2 PRODUCTS

2.1 **COMPONENTS**

A. Conduit: Section 26 05 33.

B. Concrete: Class 3000 minimum, Section 03 30 05, with No. 67 aggregate or larger and dye additive to give permanent red color.

C. Conductors: Section 26 05 13 or required by NFPA 70.

D. Cable Lugs: Suitable for application.

E. Duct Spacers: Fabricated plastic, UL approved.

F. Meter Sockets: Comply with requirements of power utility company.

G. Metering: Sized to capacity of main switch or buss as applicable.

2.2 **BACKFILL**

A. Sand fill, Section 31 05 13.

B. Aggregate base course, Section 32 11 23.

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. Excavation, Section 31 23 16.

3.2 INSTALLATION

A. Provide adaptation from conduit to PVC duct.

B. Slope service to drainage point.

C. Terminate service conduit in main panel and transformer with grounding bushings. Make suitable ground connection from bushing to distribution center ground bus.

D. Install on undisturbed soil where possible. Comply with backfill and compaction requirements of Section 31 23 26.

3.3 DUCTBANK

A. Place concrete so voids around ducts are filled.

B. Provide minimum concrete thickness between ducts of two (2) inches.

C. Adjust final slopes on site to coordinate with existing utilities.

D. Install drain assembly with saddle cutouts for each conduit. Tape drain assembly to each conduit to prevent entrance of concrete. Band drain assembly with 1/2 inch stainless steel straps to conduit assembly to prevent mechanical displacement. Connect to piping drain.

E. After installation, clean and swab ducts.

F. Install galvanized steel pull wires in spare ducts. Cap spare ducts.

3.4 DIRECT BURIAL

A. Level trench with three (3) inches minimum layer of sand. Cover conductors with six (6) inches layer of sand. Provide physical protection acceptable to electrical authority having jurisdiction.

3.5 SERVICE INSTALLATION

A. Provide duct bank from property line or supply authority's pole to transformer or building as required.

B. Coordinate with utility company to install conductor from source to meter. Coordinate trenching, supplying and placing of sand and backfilling with power utility company.

3.6 FIELD QUALITY CONTROL

A. Inspect, splice and test continuity for all special telemetry cables before backfilling trenches.

END OF SECTION

APPENDIX No. 2 - GEOTECHNICAL DATA

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 Evaluation Report for Project, prepared by GSH Geotechnical, dated May 29, 2024, is available for viewing as Appendix No#2, 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.

Geotechnical Evaluation Report – Update

Proposed Logan Seminary
110 West 100 South
Logan, Utah (41.7292°, -111.8380°)
LDS Property No.: 502-245323010101

Prepared for:
The Church of Jesus Christ of Latter-day Saints
Utah North PM Office
435 North Wall Avenue, Suite D
Ogden, Utah 84404

GSH

Prepared by
GSH Geotechnical
May 29, 2024

473 West 4800 South, Murray, UT, Phone (801)-685-9190, Fax (801)-685-2990, Email Address mike@gshgeotech.com

May 29, 2024
Job No. 0153-521-24

The Church of Jesus Christ of Latter-day Saints
Utah North PM Office
435 North Wall Avenue, Suite D
Ogden, Utah 84404

Mr. Brian Childs:

Re: Geotechnical Evaluation Report – Update
Proposed Logan Seminary
110 West 100 South
Logan, Utah (41.7292°, -111.8380°)
LDS Property Number: 502-245323010101

1. EXECUTIVE SUMMARY

This report presents the results of the geotechnical study performed at the site of the proposed Logan Seminary to be located at 110 West 100 South in Logan, Utah.

The soils across the site were generally similar at the boring locations. Borings were completed to depths ranging from 16.5 to 46.5 feet. The borings were performed within existing grassy lawn areas and encountered up to approximately 3 inches of topsoil. Topsoil thickness is frequently erratic and thicker zones of topsoil should be anticipated. Non-engineered fills soils were encountered in both borings to depths of up to 6.5 feet below the existing ground surface. The non-engineered fill soil primarily consisted of clay with varying silt, sand, gravel, and cobble content. Natural soils were encountered below the non-engineered fill in each boring. The natural soils primarily consisted of sand and gravel with varying silt content overlying clay with varying silt, sand, and gravel content.

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

The natural clay soils were soft to very stiff, saturated, and gray in color.

Groundwater was measured within the borings at a depth as shallow as 8.2 feet. Based on the anticipated cuts necessary to reach design subgrades, we do not anticipate significant groundwater

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control problems during mass grading operations. However, temporary dewatering may be required for deeper excavations, such as those for utility construction and/or for the removal of non-engineered fills.

The most significant geotechnical aspects of the site are the existing structure and utilities that are to be demolished/relocated, the existing non-engineered fills encountered throughout the site, the relatively shallow depth to groundwater, and the potentially liquifiable soils.

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

Based upon our review of available literature, no active faults are known to pass through or immediately adjacent to the site. The nearest active fault consists of the central section of the East Cache fault zone located 2.3 miles to the east of the site.

Due to liquefiable soils being present, the site has been determined to be Site Class F (in accordance with Section 20.3.1, Site Class F of ASCE 7-16). According to ASCE 7-16, a site-specific response analysis is required unless the structure meets the requirements of the exception provided in Section 20.3.1. GSH understands that the proposed structure will have a fundamental period of vibration of less than 0.5 seconds and will therefore meet the exception and a site-specific response analysis is not required.

Based on our analysis, the loose to medium dense, saturated sand layers encountered in Boring B-2 could liquefy during the design seismic event. Calculated settlement associated with the liquefaction within the boring was less than 1.5 inches. This magnitude of settlement must be evaluated by the structural engineer to design for life safety. Additionally, lateral spread and ground rupture are unlikely to occur.

2. INTRODUCTION

This report presents the results of the geotechnical study performed at the site of the proposed Logan Seminary located at 110 West 100 South in Logan, Utah. The general location of the site with respect to existing roadways, as of 2024, is presented on Figure 1, Vicinity Map. A more detailed aerial image of the site showing the existing facilities and roadways is presented on Figure 2, Site Plan. The approximate locations of the borings completed in conjunction with this study are also presented on Figure 2.

3. AUTHORIZATION

Authorization was provided by the client returning a signed "Agreement Between Client and Geotechnical Consultant" in accordance with our Professional Services Agreement No. 23-0908.

4. PROJECT DESCRIPTION, PURPOSE OF EVALUATION, & SCOPE OF WORK

The objectives and scope of our study were planned in discussions between Mr. Brian Childs of The Church of Jesus Christ of Latter-day Saints and Mr. Mike Huber of GSH Geotechnical, Inc. (GSH).

In general, the objectives of this study were to:

1. Define and evaluate the subsurface soil and groundwater conditions.

2. Provide appropriate foundation, earthwork, and geoseismic recommendations to be utilized in the design and construction of the proposed facility.

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

1. A field program consisting of the drilling, logging, and sampling of 2 borings.

2. A laboratory testing program.

3. An office program consisting of the correlation of available data, engineering analysis, and the preparation of this summary report.

5. PROFESSIONAL STATEMENTS

Supporting data upon which our recommendations are based are presented in subsequent sections of this report. Recommendations presented herein are governed by the physical properties of the soils encountered in the exploration borings, projected groundwater conditions, and the layout and design data discussed in Section 6, Design Criteria, of this report. If subsurface conditions other than those described in this report are encountered and/or if design and layout changes are implemented, GSH must be informed so that our recommendations can be reviewed and amended, if necessary.

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

6. DESIGN CRITERIA

The seminary structure will be constructed on an approximately 0.5-acre parcel and have a footprint of approximately 4,500 square feet. The structure is anticipated to be 1- to 1-extended level of wood-frame construction, established slab-on-grade, and supported over conventional spread and continuous wall footings.

Maximum real column and wall loads are anticipated to be up to 60 kips and up to 3 kips per lineal foot, respectively. Real loads are defined as the total of all dead plus frequently applied (reduced) live loads.

At-grade paved parking and drive lane areas will be part of the overall site development. Projected traffic in the parking areas is anticipated to consist of a light volume of automobiles and light trucks with no medium-weight or heavyweight trucks. In primary drive areas within the church parking lot, traffic is projected to consist of a light volume of automobiles and light trucks with occasional medium-weight and heavyweight trucks (mainly garbage trucks).

Maximum site grading cuts and fills are anticipated to be on the order of 1 to 2 feet.

7. SITE CONDITIONS

The site is located at 110 West 100 South in Logan, Utah. The site is currently developed with an existing seminary church structure and associated pavements. The site is relatively flat with a slight slope to the south with a total relief of 10 to 12 feet. Site vegetation consists of grassy landscaped areas and mature trees surrounding the existing structure.

The site is bounded to the north by 100 South Street followed by a single-family residential structure; to the east by 100 West Street followed by a multi-family apartment structure; and to the south and west by Logan High School.

8. FIELD STUDY

In order to define and evaluate the subsurface soil and groundwater conditions across the site, 2 borings were extended to depths ranging from 16.5 to 46.5 feet below existing grades. The borings were drilled using a truck-mounted drill rig equipped with hollow-stem augers. The approximate locations of the borings are presented on Figure 2.

The field portion of our study was under the direct control and continual supervision of an experienced member of our geotechnical staff. During the course of the drilling operations, a continuous log of the subsurface conditions encountered was maintained. In addition, samples of the typical soils encountered were obtained for subsequent laboratory testing and examination. The soils were classified in the field based upon visual and textural properties. These classifications were later supplemented by subsequent inspection and testing in our laboratory. Detailed graphical representation of the subsurface conditions encountered is presented on

Figures 3A and 3B, Boring Logs. Soils were classified in accordance with the nomenclature described on Figure 4, Key to Boring Log (USCS).

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

Following completion of exploration operations, 1.25-inch diameter slotted PVC pipe was installed in each boring to provide a means of monitoring the groundwater fluctuations. The borings were backfilled with auger cuttings.

9. SUBSURFACE CONDITIONS AND GROUNDWATER

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

The borings were completed to depths ranging from 16.5 to 46.5 feet. The soil conditions encountered in each of the borings, to the depths completed, were generally similar across the boring locations.

The borings were performed within existing grassy lawn areas and encountered up to approximately 3 inches of topsoil. Topsoil thickness is frequently erratic and thicker zones of topsoil should be anticipated. Non-engineered fills soils were encountered in both borings to depths of up to 6.5 feet below the existing ground surface. The non-engineered fill soil primarily consisted of clay with varying silt, sand, gravel, and cobble content. Natural soils were encountered below the non-engineered fill in each boring. The natural soils primarily consisted of sand and gravel with varying silt content overlying clay with varying silt, sand, and gravel content.

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

The natural clay soils were soft to very stiff, saturated, and gray in color.

For additional details pertaining to the subsurface conditions encountered, please refer to Figures 3A and 3B, Boring Logs. The lines designating the interface between soil types on the boring logs generally represent approximate boundaries. In situ, the transition between soil types may be gradual.

Groundwater was measured as shallow as 8.2 feet below the existing ground surface. Based on the anticipated cuts necessary to reach design subgrades, we do not anticipate significant groundwater control problems during mass grading operations. However, temporary dewatering may be

required for deeper excavations, such as those for utility construction and/or for the removal of non-engineered fills.

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

10. LABORATORY TESTING

10.1 General

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

10.2 Moisture and Density Tests

To aid in classifying the soils and to help correlate other test data, moisture and density tests were performed on selected samples. The results of these tests are presented on the logs, Figures 3A and 3B.

10.3 Partial Gradation Tests

To aid in classifying the granular soils, partial gradation tests were performed. Results of the tests are tabulated below and presented on the boring logs, Figures 3A and 3B:

Boring/ No.	Depth (feet)	Percent Passing No. 200 Sieve	Moisture Content Percent	Soil Classification
B-1	2.5	5.5	4.5	GP/GM
	7.5	5.5	3.5	GP/GM
B-2	10.0	6.3	16.8	SP/SM
	15.0	27.2	25.6	SM
	20.0	25.0	25.0	SM

10.4 Atterberg Limits Test

To aid in classifying the soils, an Atterberg limits test is being performed on a sample of the fine-grained cohesive soils. Results of the test will be transmitted to you upon completion.

10.6 Chemical Tests

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

10.7 Topsoil Tests

A series of topsoil tests are being performed on a representative surface sample. The results of the tests will be transmitted to you upon completion.

11. RECOMMENDATIONS AND CONCLUSIONS

11.1 SUMMARY OF FINDINGS

The results of the study indicate that the proposed structure may be supported upon conventional spread and continuous wall foundations established upon suitable natural granular soils or granular structural fill extending to suitable natural granular soils.

The most significant geotechnical aspects at the site are:

1. The existing structure and utilities on the site that are to be demolished/relocated.

2. The existing non-engineered fills encountered to depths of up to 6.5 feet below the ground surface.

3. The relatively shallow depth to groundwater with respect to utilities and non-engineered fills.

4. The potentially liquefiable sand layers encountered in Boring B-2.

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

Due to the developed nature of this site and the surrounding area, additional non-engineered fills may exist in unexplored areas of the site. Based on our experience, non-engineered fills are frequently erratic in composition and consistency. All surficial loose/disturbed soils and non-engineered fills must be removed below all footings, floor slabs, and pavements.

Groundwater was measured as shallow as 8.2 feet below the ground surface. GSH recommends placing floor slabs no closer than 4 feet from the highest groundwater elevation. Site grading fill may be utilized to raise the overall grade to achieve the required separation between the floor slab and the highest groundwater elevation (if necessary).

Proof rolling of the natural subgrade must not be completed if cuts extend to within 1 foot of the groundwater surface. In areas where cuts are to extend to within 1 foot of the groundwater surface, stabilization must be anticipated.

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

Loose, saturated sand layers were encountered in Boring B-2. Due to liquefiable soils being present, the site has been determined to be Site Class F (in accordance with Section 20.3.1, Site Class F of ASCE 7-16). According to ASCE 7-16, a site-specific response analysis is required unless the structure meets the requirements of the exception provided in Section 20.3.1. GSH understands that the proposed structure will have a fundamental period of vibration of less than 0.5 seconds and will therefore meet the exception and a site-specific response analysis is not required.

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

11.2 EARTHWORK

11.2.1 Site Preparation

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

Subsequent to stripping and prior to the placement of floor slabs, foundations, structural site grading fills, exterior flatwork, and pavements, the exposed subgrade must be proof rolled by passing moderate-weight rubber tire-mounted construction equipment over the surface at least twice. If excessively soft or otherwise unsuitable soils are encountered beneath footings, they must be completely removed. If removal depth required is greater than 2 feet below footings, GSH must be notified to provide further recommendations. In pavement, floor slab, and outside flatwork areas, unsuitable natural soils should be removed to a maximum depth of 2 feet and replaced with compacted granular structural fill.

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

Due to the relatively high groundwater, site grading cuts should be kept to a minimum. Cuts extending to within 1 foot of the groundwater elevation will likely disturb the natural soils and proof rolling must not be completed. Stabilization must be anticipated in areas where cuts are to extend to within 1 foot of the groundwater surface.

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

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

11.2.2 Temporary Excavations

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

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

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

The static groundwater table was encountered as shallow as 8.2 feet below the existing surface and may be shallower with seasonal fluctuations. Consideration for dewatering of utility trenches, excavations for the removal of non-engineered fill, and other excavations below this level should be incorporated into the design and bidding process.

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

11.2.3 Structural Fill

Structural fill is defined as all fill which will ultimately be subjected to structural loadings, such as imposed by footings, floor slabs, pavements, etc. Structural fill will be required as backfill over foundations and utilities, as site grading fill, and as replacement fill below footings. All structural

fill must be free of surface vegetation, root systems, rubbish, topsoil, frozen soil, and other deleterious materials.

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

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

Only granular soils are recommended as structural fill in confined areas, such as around foundations, within utility trenches, and as replacement fill below foundations.

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

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

11.2.4 Fill Placement and Compaction

All structural fill shall be placed in lifts not exceeding 8 inches in loose thickness. Structural fills shall be compacted in accordance with the percent of the maximum dry density as determined by the AASHTO[1] T180 (ASTM[2] D1557) compaction criteria in accordance with the table on the following page.

[1] American Association of State Highway and Transportation Officials
[2] American Society for Testing and Materials

Location	Total Fill Thickness (feet)	Minimum Percentage of Maximum Dry Density
Beneath an area extending at least 5 feet beyond the perimeter of the structure	0 to 5	95
	5 to 10*	100
Site grading fills outside area defined above	0 to 5	90
	5 to 10*	100
Utility trenches within structural areas	--	96
Road base	--	96

* For structural fill sequences greater than 5 feet thick and up to 10 feet thick, the entire fill sequence must be compacted to 100 percent of the maximum dry density and compaction shall be performed at 0- to 3-percent over the optimum moisture content.

Structural fills greater than 10 feet thick are not anticipated at the site.

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

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

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

11.2.5 Utility Trenches

All utility trench backfill material below structurally loaded facilities (footings, floor slabs, flatwork, pavements, etc.) shall be placed at the same density requirements established for structural fill. If the surface of the backfill becomes disturbed during the course of construction, the backfill shall be proof rolled and/or properly compacted prior to the construction of any exterior flatwork over a backfilled trench. Proof rolling shall be performed by passing moderately loaded

rubber tire-mounted construction equipment uniformly over the surface at least twice. If excessively loose or soft areas are encountered during proof rolling, they shall be removed to a maximum depth of 2 feet below design finish grade and replaced with structural fill.

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

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

The static groundwater table was encountered as shallow as 8.2 feet below the existing surface and may be shallower with seasonal fluctuations. Dewatering of utility trenches and other excavations below this level should be anticipated.

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

11.3 GROUNDWATER

On February 28, 2024 (16 days following drilling), groundwater was measured within the PVC pipes installed as tabulated below:

Boring No.	Groundwater Depth (feet)
	February 28, 2024
B-1	15.4
B-2	8.2

Based on the anticipated cuts necessary to reach design subgrades, we do not anticipate significant groundwater control problems during mass grading operations. However, temporary dewatering may be required for deeper excavations, such as those for utility construction and/or for the removal of non-engineered fills.

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

depths than those measured during this study, including during construction and over the life of the structure.

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

11.4 SPREAD AND CONTINUOUS WALL FOUNDATIONS

11.4.1 Design Data

The results of our analysis indicate that the proposed structures may be supported upon conventional spread and continuous wall foundations established upon suitable natural granular soils and/or structural fill extending to suitable natural granular soils. For design, the following parameters are provided with respect to the projected loading discussed in Section 6, Design Criteria, of this report:

Minimum Recommended Depth of Embedment for Frost Protection	- 30 inches
Minimum Recommended Depth of Embedment for Non-frost Conditions	- 15 inches
Recommended Minimum Width for Continuous Wall Footings	- 18 inches
Minimum Recommended Width for Isolated Spread Footings	- 24 inches
Recommended Net Bearing Capacity for Real Load Conditions for Footings Established Upon Suitable Natural Granular Soils	- 3,000 pounds per square foot
Bearing Capacity Increase for Seismic Loading	- 50 percent

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

11.4.2 Installation

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

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

11.4.3 Settlements

Based on column loadings, soil bearing capacities, and the foundation recommendations as discussed above, settlements are anticipated to be less than one inch.

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

11.5 LATERAL RESISTANCE

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

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

11.6 FLOOR SLABS

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

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

achieve the required separation between the floor slab and the highest groundwater elevation (if necessary).

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

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

GSH recommends placing floor slabs no closer than 4 feet from the highest groundwater elevation.

In accordance with the Geotechnical Evaluation Report Template, floor slabs are to be constructed without control or construction joints, are reinforced with No. 4 bars at 18 inches on-center each way and shall include a 15-mil vapor retarder placed directly under the concrete with at least 4 inches of "free-draining" fill, described previously, placed below the vapor retarder.

11.7 PAVEMENTS

The natural granular soils will exhibit moderate pavement support characteristics when saturated. All pavement areas must be prepared as previously discussed (see Section 11.2.1, Site Preparation). Under no circumstances shall pavements be established over loose or disturbed soils, non-engineered soils (if encountered), topsoil, surface vegetation, root systems, rubbish, construction debris, other deleterious materials, frozen soils, or within ponded water. With the subgrade soils and the projected traffic as discussed in Section 2, Proposed Construction, the following pavement sections are recommended.

Parking Areas

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

Flexible:

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

Rigid:

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

Parking Lot Drive Lanes and Access Driveways

(Moderate Volume of Automobiles and Light Trucks,
Light Volume of Medium-Weight Trucks,
and Occasional Heavyweight Trucks)
[15 equivalent 18-kip axle loads per week]

Flexible:

3.0 inches	Asphalt concrete
9.0 inches	Aggregate base
Over	Properly prepared natural subgrade soils and/or structural site grading fill extending to suitable natural subgrade soils

Rigid:

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

For trash enclosure and associated approach slabs (one 40,000-pound axel load per week), we recommend a pavement section consisting of 8.0 inches of Portland cement concrete, 12.0 inches of aggregate base, over properly prepared and stabilized natural subgrade or site grading structural fills extending to suitable stabilized natural soils.

The above rigid pavement sections are for non-reinforced Portland cement concrete. Concrete should be designed in accordance with the American Concrete Institute (ACI) and joint details should conform to the Portland Cement Association (PCA) guidelines. The concrete shall have a minimum 28-day unconfined compressive strength of 4,500 pounds per square inch, contain 6 percent ±1 percent air-entrainment, and meet the requirements given below in Section 11.8, Cement Types, of this report. In accordance with the Geotechnical Evaluation Report Template, 25 percent fly ash is required in all concrete exposed to freeze-thaw cycles and deicers.

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

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

11.8 CEMENT TYPES

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

11.9 DOWNSPOUTS

It is recommended that all surface water be directed away from the building with positive drainage measures, including downspouts.

11.10 GEOSEISMIC SETTING

11.10.1 General

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

11.10.2 Faulting

Based upon our review of available literature, no active faults are known to pass through or immediately adjacent to the site. The nearest active fault consists of the central section of the East Cache fault zone located 2.3 miles to the east of the site.

11.10.3 Soil Class

Due to liquefiable soils being present, the site has been determined to be Site Class F (in accordance with Section 20.3.1, Site Class F of ASCE 7-16). According to ASCE 7-16, a site-specific response analysis is required unless the structure meets the requirements of the exception provided in Section 20.3.1. GSH understands that the proposed structure will have a fundamental period of vibration of less than 0.5 seconds and will therefore meet the exception and a site-specific response analysis is not required.

The spectral accelerations may be determined by using a Site Class D-Default Soil Profile (in accordance with Section 20.3 and the corresponding values of F_a and F_v determined from Tables 11.4-1 and 11.4-2). If a measured site class in accordance with IBC 2021/ASCE 7-16 is beneficial based on the project structural engineer's review, please contact GSH for additional options for obtaining this measured site class.

11.10.4 Ground Motions

The IBC 2021 code is based on USGS mapping, which provides values of short and long period accelerations for average bedrock values for the Western United States and must be corrected for local soil conditions. The following table summarizes the peak short and long period accelerations for the MCE event and incorporates the appropriate soil amplification factor for a Site Class D – Default* Soil Profile. Based on the site latitude and longitude (41.7292 degrees north and 111.8380 degrees west, respectively) and Risk Category II, the values for this site are tabulated below:

Spectral Acceleration Value, T	Bedrock Boundary [mapped values] (% g)	Site Coefficient	Site Class D - Default* [adjusted for site class effects] (% g)	Design Values (% g)
0.2 Seconds (Short Period Acceleration)	S_S = 107.2	F_a = 1.200	S_{MS} = 128.6	S_{DS} = 85.7
1.0 Second (Long Period Acceleration)	S_1 = 35.8	F_v = 1.942	S_{M1} = 69.5	S_{D1} = 46.3

* See Section 11.10.3, Soil Class

11.10.5 Liquefaction

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

Calculations were performed using the procedures described in the 2014 Soil Liquefaction During Earthquakes Monograph by Idriss and Boulanger[3]. Our calculations indicate the loose to medium dense, saturated sand layers encountered in Boring B-2 could liquefy during the design seismic event. Calculated settlement associated with the liquefaction within the boring was less than 1.5 inches. This magnitude of settlement must be evaluated by the structural engineer to design for life safety. Additionally, lateral spread and ground rupture are unlikely to occur.

11.11 SITE VISITS

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

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

11.12 CLOSURE

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

Respectfully submitted,

GSH Geotechnical, Inc.

Michael S. Huber, P.E.
State of Utah No. 343650
Vice President/Senior Geotechnical Engineer

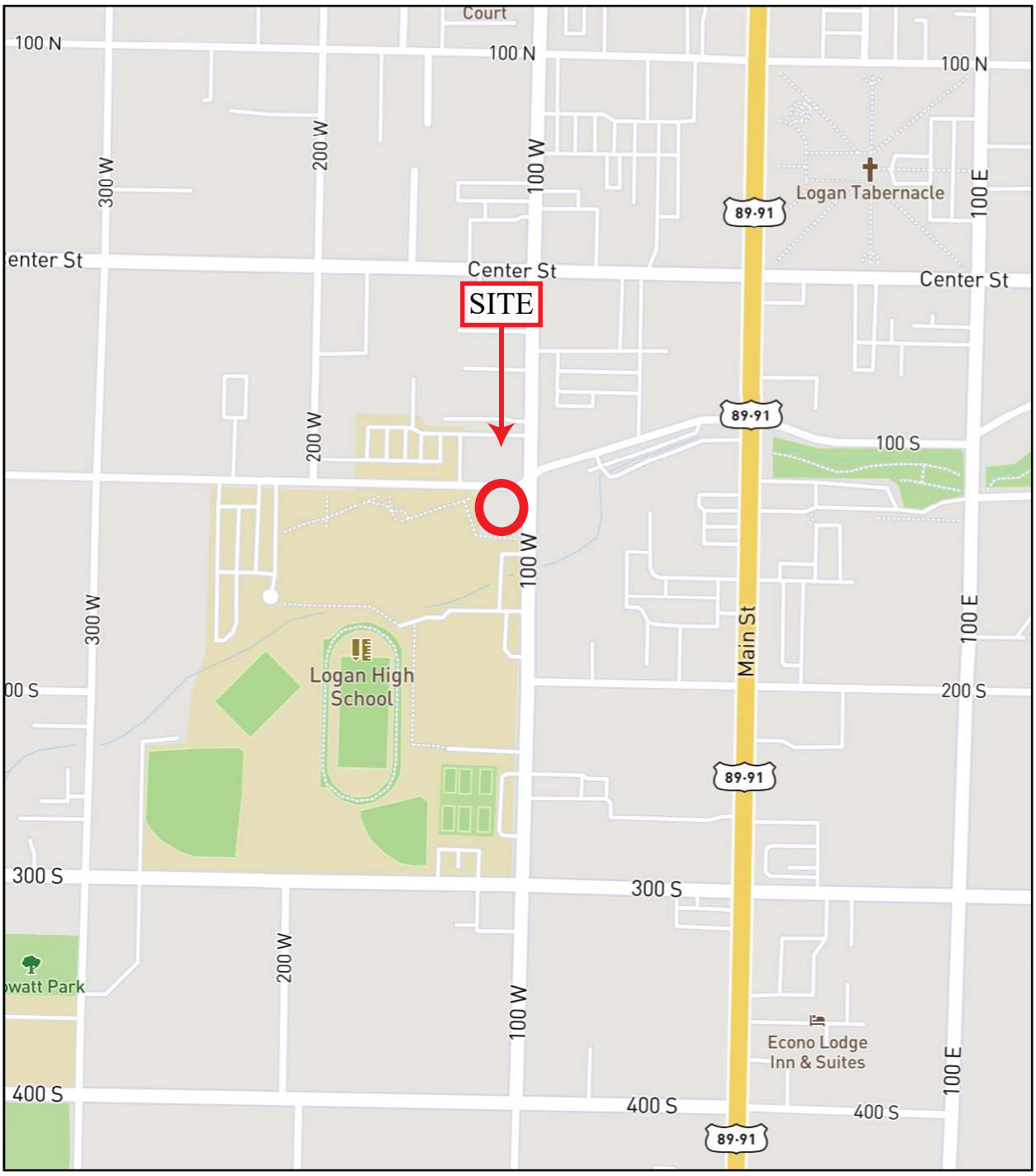
MSH:jmt

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

Addressee: (email)

cc: Matt McBride (mattm@arwengineers.com)
Adam Ferguson (aferguson@ffkr.com)

THE CHURCH OF JESUS CHRIST OF LATTER-DAY SAINTS
JOB NO. 0153-521-24



0.05 0 0 0 0 0 0.05 0.1 0.15 MI 0.2

100 0 0 100 200 M 300

FIGURE 1
VICINITY MAP

REFERENCE:
ALL TRAILS - NATIONAL GEOGRAPHIC TERRAIN
DATED 2024

GSH

THE CHURCH OF JESUS CHRIST OF LATTER-DAY SAINTS
JOB NO. 0153-521-24

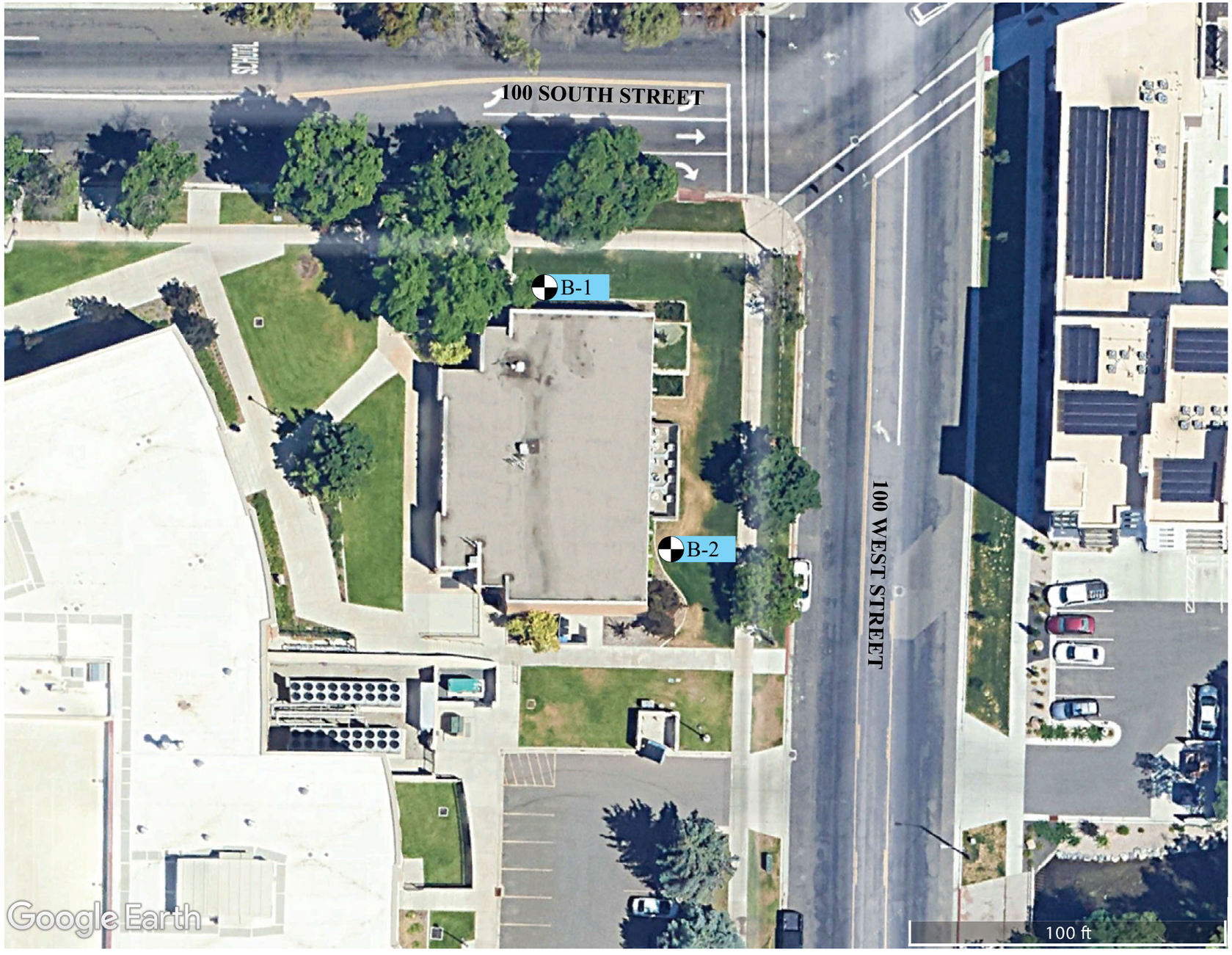


FIGURE 2
SITE PLAN

REFERENCE:
ADAPTED FROM AERIAL PHOTOGRAPH
DOWNLOADED FROM GOOGLE EARTH
IMAGERY DATED 7/2023

GSH

BORING LOG

Page: 1 of 1

BORING: B-1

CLIENT: The Church of Jesus Christ of Latter-day Saints | PROJECT NUMBER: 0153-521-24

PROJECT: Proposed Logan Seminary | DATE STARTED: 2/12/24 | DATE FINISHED: 2/12/24

LOCATION: 110 West 100 South, Logan, Utah (41.7292°, -111.8380°) | GSH FIELD REP.: JC

DRILLING METHOD/EQUIPMENT: 4-1/4" ID Hollow-Stem Auger | HAMMER: Automatic | WEIGHT: 140 lbs | DROP: 30"

GROUNDWATER DEPTH: 15.4' (2/28/24) | ELEVATION: ---

WATER LEVEL	USCS	DESCRIPTION	DEPTH (FT.)	BLOW COUNT	SAMPLE SYMBOL	MOISTURE (%)	DRY DENSITY (PCF)	% PASSING 200	LIQUID LIMIT (%)	PLASTICITY INDEX	REMARKS
		Ground Surface	0								
	CL FILL	FINE TO COARSE SANDY CLAY, FILL with fine and coarse gravel; major roots (topsoil) to 3"; brown									slightly moist medium stiff
	GP/ GM	FINE AND COARSE GRAVEL with some silt and fine to coarse sand; brown									slightly moist medium dense
				62		4.5		5.5			
			5								
				73							moist dense
				37		3.5		5.5			
			10								
▼			15	86		5.5	95				saturated
		End of Exploration at 16.5'. No groundwater encountered at time of drilling. Installed 1.25" diameter slotted PVC pipe to 16.5'.	20								
			25								

See Subsurface Conditions section in the report for additional information.

FIGURE 3A

BORING LOG

Page: 1 of 2

BORING: B-2

CLIENT: The Church of Jesus Christ of Latter-day Saints | PROJECT NUMBER: 0153-521-24

PROJECT: Proposed Logan Seminary | DATE STARTED: 2/12/24 | DATE FINISHED: 2/12/24

LOCATION: 110 West 100 South, Logan, Utah (41.7292°, -111.8380°) | GSH FIELD REP.: JC

DRILLING METHOD/EQUIPMENT: 4-1/4" ID Hollow-Stem Auger | HAMMER: Automatic | WEIGHT: 140 lbs | DROP: 30"

GROUNDWATER DEPTH: 8.2' (2/28/24) | ELEVATION: ---

WATER LEVEL	USCS	DESCRIPTION	DEPTH (FT.)	BLOW COUNT	SAMPLE SYMBOL	MOISTURE (%)	DRY DENSITY (PCF)	% PASSING 200	LIQUID LIMIT (%)	PLASTICITY INDEX	REMARKS
		Ground Surface	0								
	CL FILL	SILTY CLAY, FILL with fine and coarse gravel, trace fine sand, and cobbles; major roots (topsoil) to 3"; brown									moist very stiff
				26							
			5								
				10							
		grades with trace coarse sand									
	SP/ SM	FINE TO COARSE SAND with fine and coarse gravel and some silt; brown									moist medium dense
▼											saturated
			10	14		16.8		6.3			
	SM	SILTY FINE TO COARSE SAND with layers of clay up to 1/4" thick; brown									saturated loose
			15	9		25.6		27.2			
		grades with layers of clay up to 2" thick	20	7		25.0		25.0			
	CL	SILTY CLAY with trace fine sand; gray									saturated medium stiff
			25								

See Subsurface Conditions section in the report for additional information.

FIGURE 3B

BORING LOG

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BORING: B-2

CLIENT: The Church of Jesus Christ of Latter-day Saints | PROJECT NUMBER: 0153-521-24

PROJECT: Proposed Logan Seminary | DATE STARTED: 2/12/24 | DATE FINISHED: 2/12/24

WATER LEVEL	USCS	DESCRIPTION	DEPTH (FT.)	BLOW COUNT	SAMPLE SYMBOL	MOISTURE (%)	DRY DENSITY (PCF)	% PASSING 200	LIQUID LIMIT (%)	PLASTICITY INDEX	REMARKS
			25								
		grades with trace coarse sand and fine gravel		6							
			30								
		gravel grades out		3							soft
			35								
				12							stiff
			40								
				24							very stiff
			45								
				4							medium stiff
		End of Exploration at 46.5'. Installed 1.25" diameter slotted PVC pipe to 46.5'.	50								

See Subsurface Conditions section in the report for additional information.

FIGURE 3B
(continued)

CLIENT: The Church of Jesus Christ of Latter-day Saints
PROJECT: Proposed Logan Seminary
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KEY TO BORING LOG

WATER LEVEL	USCS	DESCRIPTION	DEPTH (FT.)	BLOW COUNT	SAMPLE SYMBOL	MOISTURE (%)	DRY DENSITY (PCF)	% PASSING 200	LIQUID LIMIT (%)	PLASTICITY INDEX	REMARKS
①	②	③	④	⑤	⑥	⑦	⑧	⑨	⑩	⑪	⑫

COLUMN DESCRIPTIONS

① **Water Level:** Depth to measured groundwater table. See symbol below.

② **USCS:** (Unified Soil Classification System) Description of soils encountered; typical symbols are explained below.

③ **Description:** Description of material encountered; may include color, moisture, grain size, density/consistency,

④ **Depth (ft.):** Depth in feet below the ground surface.

⑤ **Blow Count:** Number of blows to advance sampler 12" beyond first 6", using a 140-lb hammer with 30" drop.

⑥ **Sample Symbol:** Type of soil sample collected at depth interval shown; sampler symbols are explained below.

⑦ **Moisture (%):** Water content of soil sample measured in laboratory; expressed as percentage of dryweight of

⑧ **Dry Density (pcf):** The density of a soil measured in laboratory; expressed in pounds per cubic foot.

⑨ **% Passing 200:** Fines content of soils sample passing a No. 200 sieve; expressed as a percentage.

⑩ **Liquid Limit (%):** Water content at which a soil changes from plastic to liquid behavior.

⑪ **Plasticity Index (%):** Range of water content at which a soil exhibits plastic properties.

⑫ **Remarks:** Comments and observations regarding drilling or sampling made by driller or field personnel. May include other field and laboratory test results using the following abbreviations:

CEMENTATION:

Weakly: Crumbles or breaks with handling or slight finger pressure.

Moderately: Crumbles or breaks with considerable finger pressure.

Strongly: Will not crumble or break with finger pressure.

MODIFIERS:

Trace <5%

Some 5-12%

With > 12%

MOISTURE CONTENT (FIELD TEST):

Dry: Absence of moisture, dusty, dry to the touch.

Moist: Damp but no visible water.

Saturated: Visible water, usually soil below water table.

Descriptions and stratum lines are interpretive; field descriptions may have been modified to reflect lab test results. Descriptions on the logs apply only at the specific boring locations and at the time the borings were advanced; they are not warranted to be representative of subsurface conditions at other locations or times.

UNIFIED SOIL CLASSIFICATION SYSTEM (USCS)

MAJOR DIVISIONS			USCS SYMBOLS	TYPICAL DESCRIPTIONS
COARSE-GRAINED SOILS More than 50% of material is larger than No. 200 sieve size.	GRAVELS More than 50% of coarse fraction retained on No. 4 sieve.	CLEAN GRAVELS (little or no fines)	GW	Well-Graded Gravels, Gravel-Sand Mixtures, Little or No Fines
			GP	Poorly-Graded Gravels, Gravel-Sand Mixtures, Little or No Fines
		GRAVELS WITH FINES (appreciable amount of fines)	GM	Silty Gravels, Gravel-Sand-Silt Mixtures
			GC	Clayey Gravels, Gravel-Sand-Clay Mixtures
	SANDS More than 50% of coarse fraction passing through No. 4 sieve.	CLEAN SANDS (little or no fines)	SW	Well-Graded Sands, Gravelly Sands, Little or No Fines
			SP	Poorly-Graded Sands, Gravelly Sands, Little or No Fines
		SANDS WITH FINES (appreciable amount of fines)	SM	Silty Sands, Sand-Silt Mixtures
			SC	Clayey Sands, Sand-Clay Mixtures
FINE-GRAINED SOILS More than 50% of material is smaller than No. 200 sieve size.	SILTS AND CLAYS Liquid Limit less than 50%		ML	Inorganic Silts and Very Fine Sands, Rock Flour, Silty or Clayey Fine Sands or Clayey Silts with Slight Plasticity
			CL	Inorganic Clays of Low to Medium Plasticity, Gravelly Clays, Sandy Clays, Silty Clays, Lean Clays
			OL	Organic Silts and Organic Silty Clays o f Low Plasticity
	SILTS AND CLAYS Liquid Limit greater than 50%		MH	Inorganic Silts, Micacious or Diatomacious Fine Sand or Silty Soils
			CH	Inorganic Clays of High Plasticity, Fat Clays
			OH	Organic Silts and Organic Clays of Medium to High Plasticity
HIGHLY ORGANIC SOILS			PT	Peat, Humus, Swamp Soils with High Organic Contents

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

STRATIFICATION:

DESCRIPTION	THICKNESS
Seam	up to 1/8"
Layer	1/8" to 12"

Occasional: One or less per 6" of thickness

Numerous; More than one per 6" of thickness

TYPICAL SAMPLER GRAPHIC SYMBOLS

- Bulk/Bag Sample
- Standard Penetration Split Spoon Sampler
- Rock Core
- No Recovery
- 3.25" OD, 2.42" ID D&M Sampler
- 3.0" OD, 2.42" ID D&M Sampler
- California Sampler
- Thin Wall

WATER SYMBOL

Water Level

FIGURE 4

GSH